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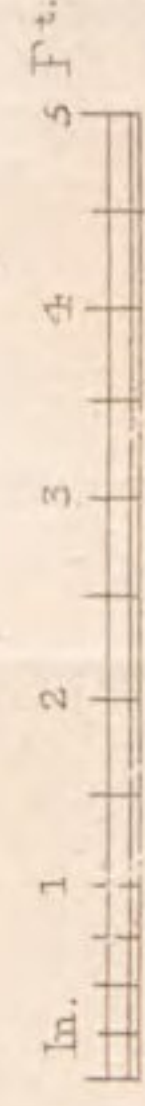
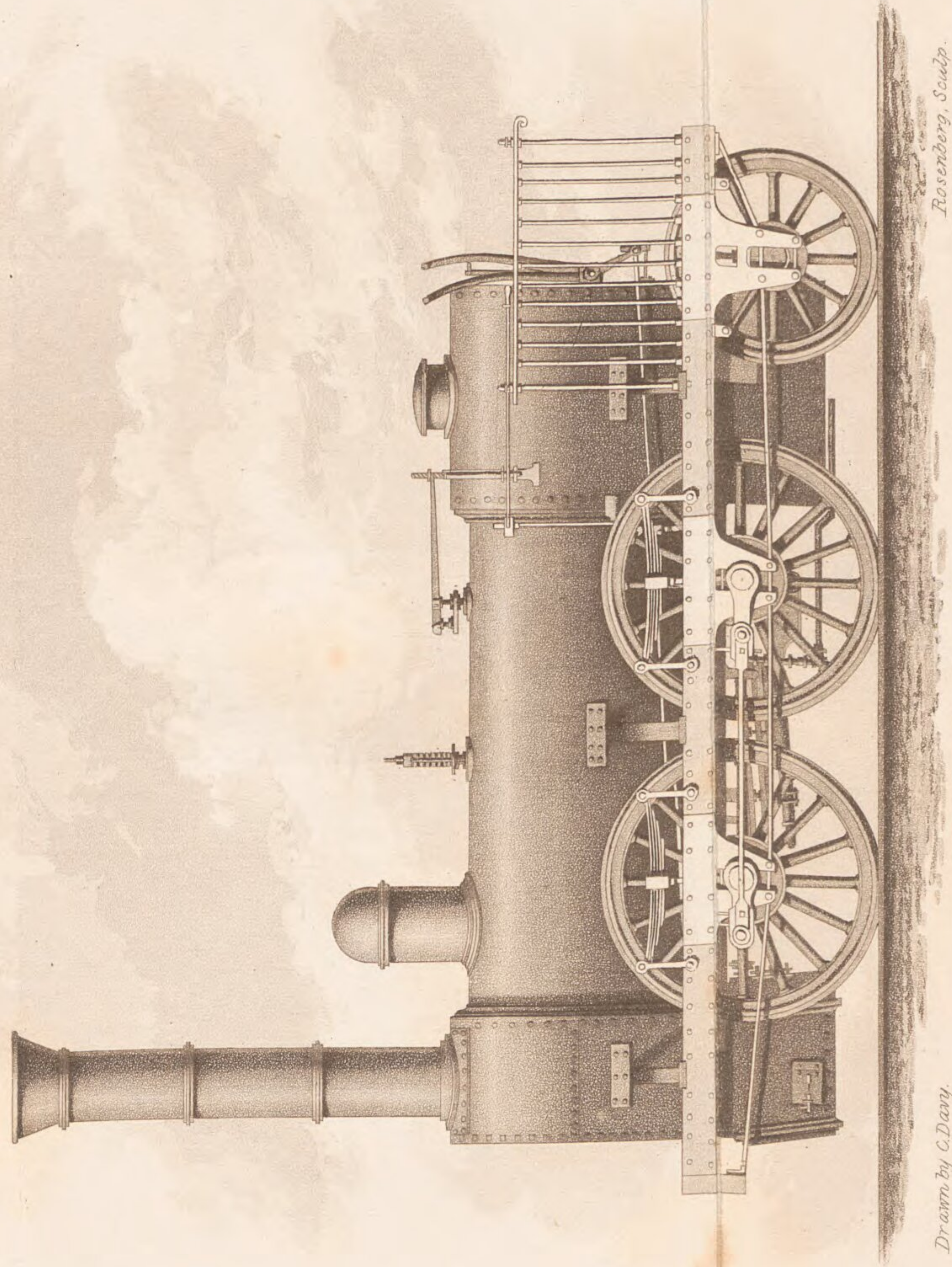


ANALYSIS OF WATER.









LOCOMOTIVE ENGINE  
ON THE STANHOPE AND TYNE RAILWAY



# ANALYSIS OF RAILWAYS:

CONSISTING OF

A SERIES OF REPORTS

ON THE

## RAILWAYS PROJECTED

IN

ENGLAND AND WALES,

IN THE YEAR M.DCCC.XXXVII.

TO WHICH ARE ADDED,

### A TABLE OF DISTANCES

FROM THE PROPOSED LONDON TERMINI TO EIGHT WELL-KNOWN PLACES

IN

### THE METROPOLIS;

WITH

### A COPIOUS GLOSSARY,

AND

### SEVERAL USEFUL TABLES.

---

BY

FRANCIS WHISHAW, CIVIL ENGINEER, M. INST. C.E.

---

—“a matter of  
the utmost national importance.”

*Report of the Select Com. on Railway Bills, Sess. 1836.*

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SECOND EDITION, WITH ADDITIONS AND CORRECTIONS.

### LONDON:

JOHN WEALE, ARCHITECTURAL LIBRARY,  
59, HIGH HOLBORN.

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1838.



# ANALYSIS OF RAILWAYS:

A SERIES OF REPORTS

ON THE

## RAILWAYS PROTECTED

IN ENGLAND AND WALES

IN THE YEAR 1845

TO WHICH ARE ADDED

## A TABLE OF DISTANCES

FROM THE LONDON TERMINUS TO EACH OF THE RAILWAYS



FRANCIS WHELAN, CIVIL ENGINEER, &c.

LONDON:

JOHN WEALE, ARCHITECTURAL LIBRARIAN

IN NEW BOND STREET

PRINTED BY COLE AND TAYLOR, CRANE-COURT, FLEET-STREET.

1846



## ADVERTISEMENT

TO

### SECOND EDITION.

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THE favourable reception which the First Edition of this Work has met with, is a gratifying assurance of its utility.

Many of the Railways described in its pages have received the sanction of the Legislature, others have been wholly or partially abandoned, and a great proportion will be found at the end of the volume, in the list of Railways for which plans have been lodged in the Private Bill Office for the Session of 1838.

The paper schemes are at an end, the Legislature having wisely interfered to prevent a recurrence of the atrocious plots of last Session, by requiring a deposit of ten per cent. on the estimated outlay to be paid into the Bank of England before any progress can be made in passing a Bill through Parliament. The list of Railways in progress has been corrected to the present time; some additions have been made to the Glossary, which contains much original information, the result of continual observations and



repeated surveys of the most important Lines in the kingdom. As affording precedents for laying out Railways, the following pages will ever continue to be useful, though the schemes described may not be carried into execution, bearing, as many of them do, the names of eminent Engineers, who have been particularly engaged in constructing Railways.

In order to prevent disappointment, Companies should be careful in employing Engineers regularly bred to the profession, and they would not have the mortification of seeing their property wasted and their works rapidly falling into decay ; while Engineers, on the other hand, should unite in preventing as much as possible untaught men from interfering with *their* rights, and thus warding off the odium which, without any distinction, is cast on the general body of the profession.

F. W.

GRAY'S INN, October 31st, 1837.



## INTRODUCTION.

---

THE subject of the following pages has been recognized by the Legislature as of national importance. No less a sum than Fifteen Millions, Three Hundred and Eighty-four Thousands sterling will be required to complete the Lines of Railway sanctioned by Parliament, during the last session; and the new schemes now progressing through the House of Commons, are estimated at Nineteen Millions, Three Hundred and Fifty-two Thousands. Of how great importance is it, then, that the utmost vigilance should be exercised, in selecting such lines, as are likely not only to confer a benefit on the Country at large, but also afford to the enterprising capitalist, a safe and profitable investment. But while we admire the spirit of those patriotic individuals who lend their fortunes in aid of the national prosperity, we are not blind to the many visionary schemes which characterize the present age, generally brought forward for the purpose of aggrandizing a few, but often ending in the ruin of many!—nor can we expect to see the legitimate projects in a thriving state, until the noxious weed is entirely eradicated.



Fully impressed with the importance of a subject involving the interests of so large a portion of the community, we have considered it entirely within our province, to analyze the several plans and sections of the projected Railways in England and Wales, which are either in their course through Parliament, or which have been abandoned for the present, for want of sufficient funds.

Brought up under the guidance of one of the first English Engineers of the present day, and having, during seventeen years' attention to engineering pursuits, had abundant opportunities of informing ourselves on the subject of Railways, and, moreover, having made repeated surveys of the principal Railways of Great Britain, we considered ourselves fully competent to the task undertaken.

The course we have pursued, enables us to present our volume to those for whom it is especially designed, at least three weeks earlier than might have been anticipated, having inspected a great proportion of the documents in the offices of the Clerks of the Peace for the Midland and Northern Counties of England, during the month of December of last year, and proceeded in January with our investigation in London, access being then had to the duplicates lodged in the Private Bill Office, as required by the new Regulations.

The salutary effects of the amended Standing Orders have already been exemplified to a considerable extent; the difficulties which heretofore existed, of



detecting errors in the sectional heights, are now to a very great degree prevented. It was no uncommon thing, for three separate results to be given, by as many parties applying their scales to ascertain the height of the railway line above some turnpike-road or canal. But, in order to render the mode of calculating the gradients perfectly sure, the length of each plane should also be expressed in the section, especially if lithographed or engraved copies still be allowed. Having gone through seventy-eight sections, we have experienced this desideratum to a considerable extent in the printed copies, where we found the contraction of the paper, and consequently of the scale, differ in almost every instance, so that in many cases the scales have been actually less than four inches to a mile, which is the *minimum* fixed by the Fourth Order. In taking the length of each plane, we were under the necessity of using a scale made to suit each particular printed plan and section. We found that the usual contraction was about  $\frac{1}{80}^{\text{th}}$ ; so that a printed plan or section of a line of railway, eighty miles in length, measured by the *minimum Parliamentary scale*, would be found extended to eighty-one miles; moreover, the contraction sometimes differs even in separate parts of the same printed plan or section.

With regard to the enlarged plans, also required by the Fourth Order, it is evident, that unless the extent of ground required for a Railway when finished be delineated thereon, such enlargements are of com-



paratively little use. In most of the enlarged plans we have inspected, the Railway is shewn by a single line only.

Fully to bear out what we have just advanced, we need only mention the case of a Railway intended to pass by an embankment fifty feet high, with the average slopes of one-and-a-half to one, and within thirty yards of a dwelling-house ; looking at the enlarged plan, the building to all appearance is saved, as the line representing the Railway is quite removed from it, but in truth the foot of the intended embankment is eighteen inches within the external face of the wall.

As a mode of easy reference from the plan to the section, it would be exceedingly desirable to show the length of Railway in miles, on the plan as well as on the section ; and, further, to mark the divisions of parishes as well on the section as on the plan. It would also be of great benefit to the public at large, if a detailed estimate for each Railway were lodged in the Private Bill Office, instead of the total cost, which is all that is at present required ; we have appended the form of such an estimate at page 265.

In addition to what we have already urged, we would suggest, that all level crossings be expressed on the section ; that the slopes of turnpike-roads and highways, intended to be altered, should also be marked thereon, for it often happens, that the intention of the Engineer is good, but that the location of such road positively prevents his design from being



carried into effect, there being in most cases but little time allowed for making sections of roads proposed to be altered ; and, lastly, that the positions of the bore holes, and a tabular statement of the strata at each point of boring, be distinctly shewn on the section ; and that at least six borings be made in each mile, where tunnelling is intended.

We may now introduce our readers to the contents of the present volume, which we believe contains all the information in the engineering department which it is possible to acquire, previously to the sittings of Committees, under the existing regulations.

The order we have adopted is, first, a detailed account of the direction of each line, fixing its location with reference to mansions, parks, houses, &c., by measurements in chains ; secondly, we point out the curves under three-quarters of a mile' radius, this being the *minimum* of curvature suited to high velocities ; thirdly, we introduce a table of the gradients, inclinations, length of each plane, and locations thereof, with distances respectively, from the point of starting ; fourthly, the tunnelling is particularly described ; fifthly, the viaducts ; sixthly, the lengths and heights, or depths of the principal earthworks ; seventhly, the number of crossings of turnpike-roads, highways, rivers, canals, &c. ; and, lastly, we introduce a summary under the head of remarks, in which we sedulously abstain from making observations detrimental to any of the proposed lines ; but when, from our own experience, we are enabled to corroborate statements, we hesitate not to do so.



We may here take occasion to mention, that we have not applied to any individual Engineer for information, but have derived the whole from the legitimate sources.

In the body of the work will be found a description of the Greenwich Railway, which is likely to become one of the principal outlets for the railways traversing the southern and south-eastern portions of England. We were chiefly induced to insert this, from the very limited knowledge which appeared to exist as to the dimensions of this work, during the examinations before Committees in the last Session of Parliament.

A detailed account will also be found of the intended Manchester and Leeds Railway, which we consider one of the most important projects of the day, whether viewed in a commercial or engineering point of view.

We have appended a table of distances from the proposed Metropolitan Railway Termini to eight principal points in London ; a table exhibiting the length, cost, &c., of each of the projected lines of Railway now under the consideration of Parliament; a table of the projected Railways abandoned for the present session ; and, lastly, a table of the Railways for which Acts were obtained in the last session, with the estimated cost, and date of each receiving the Royal Assent.

We must not omit to introduce to our readers the Summary and also the Glossary, each of which will be found in the latter pages of the volume.

And before we send forth our volume, with all its



imperfections—for such must naturally be expected in so arduous an undertaking, for which so little time has been necessarily allowed,—we gratefully acknowledge the attention of the several Clerks of the Peace for the counties of Leicester, Stafford, Chester, Lancaster, Cumberland, and Durham, and the North and West Ridings of the County of York ; and to each of the Gentlemen in the Private Bill Office, who have so readily, and all occasions, afforded us every information we have required, our especial thanks are hereby presented.







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# PROJECTED RAILWAYS:

1836-7.

---

## BATH AND WEYMOUTH GREAT WESTERN UNION RAILWAY.

ROGER HOPKINS and SONS, Civil Engineers.

### MAIN LINE—BATH TO WEYMOUTH.

THIS line is proposed to join the Great Western Railway, near the Old Bridge at Bath, and proceed within 3 chains of St. Mark's chapel, on the right,  $4\frac{1}{2}$  chains to the right of Widcombe church; thence passing, by means of a tunnel, to the left of Prior Park, 6 chains to the left of Combe Grove, 9 chains to the left of Monkton Combe, 18 chains to the left of Waterhouse; thence curving to within 15 chains of Limpley Stoke church, on the right, 10 chains to the right of Freshford church, 6 chains to the right of Stables-hill, 10 chains to the right of Iford Mill, close to Farleigh Castle; thence passing through the high ground in Hungerford parish, by means of a tunnel; close on the left of Vag's-hill and Langham Mill; thence to the town of Road, 8 chains to the right of Mirfield House, close to Clifford Mill and Kelson's Farm, intersecting the isolated portion of the parish of Boyton, Wilts; thence curving through the parishes of Berkley and Laverton, 5 chains to the left of Spring-gardens, 6 chains to the left of Leonard's Mill; thence passing within 31 chains of Frome



church on the right, 7 chains to the right of Bull's Bridge Farm, 3 chains to the right of Waldick Farm, 12 chains to the left of Monksham Farm, 2 chains to the left of Haslet-hill Farm, 4 chains to the left of Dairy Farm; thence passing within 21 chains of Witham Friary church on the right, 2 chains to the right of West-barn Farm, one chain to the right of Higher West-barn Farm, 16 chains to the left of Brewham church, 2 chains to the left of Hook-gate; thence to the left of Stoney Stoke, and continuing within half a mile, and to the west of Wincanton church, 2 chains to the left of Higher Holton, 6 chains to the right of Holton church, 9 chains to the right of North Cheriton church, 19 chains to the left of Stowel church; thence to Henstridge Bowton, within 27 chains of Purse Caundle church, on the right, close to Woodland Cottage, 11 chains to the left of Trip's Farm, leaving Pry-town on the right; 2 chains to the right of Hawkin's Farm, within 2 chains of Poll Bridge farm, on the left, 10 chains to the left of Densham, 4 chains to the right of Lower Brickshaw, within 8 chains of Water-lane Farm, on the left; 2 chains to the left of Grange House, in ruins, near which the road from Glanvilles Wooton is intended to be diverted; thence crossing Casway-common, 7 chains to the left of Mintern Parva, within 11 chains of Cerne Union workhouse, on the right, crossing the Town of Cerne Abbas, close on the left of Nether Cerne, 19 chains to the left of Godmanstone church, within 7 chains of Charminster Lunatic Asylum, on the right, and 13 chains from the church; thence, by means of a tunnel under Poundbury Camp, 2 chains to the left of Damer's barn; thence crossing Fordington-common-field, and passing under Maiden Castle, and the high ground in Monkton, Winterburn, and Upway parishes, by means of two tunnels; thence within 9 chains of Upway church, on the right, 17 chains to the left of Broadway church, 3 chains to the left of Radipole Spa; thence skirting the harbour and terminating on the Quay, and within a quarter of a mile of Weymouth Bay.



The curves in the main line, of less radius than three quarters of a mile, are as under:—

| Nos.     | Curvature in Chains. | Location.                   |
|----------|----------------------|-----------------------------|
| 1 .....  | 40 .....             | in Bradford Parish.         |
| 2 .....  | 38 .....             | near Freshford.             |
| 3 ..     | 44 .....             | Charterhouse Hinton Parish. |
| 4 .....  | 36 .....             | Wingfield Parish.           |
| 5 .....  | 39 .....             | near Shewford.              |
| 6 ..     | 45 .....             | near Staple-mead Mills.     |
| 7 .....  | 42 .....             | near Leonard's Mill.        |
| 8 .....  | 28 .....             | Horsington Parish.          |
| 9 .....  | 44 .....             | at Upway.                   |
| 10 ..... | 7 .....              | near Weymouth Terminus.     |

#### TABLE OF GRADIENTS, COMMENCING AT BATH.

Datum of Section—Level of High Water at Weymouth.

| Distance from Bath. |         | Length of each Plane. |         | Gradient. | Inclination. | Ascending or Descending. | Locations.                          |
|---------------------|---------|-----------------------|---------|-----------|--------------|--------------------------|-------------------------------------|
| Miles.              | Chains. | Miles.                | Chains. | Feet.     |              |                          |                                     |
|                     | 28½     |                       | 28½     |           |              | Level                    |                                     |
| 2                   | 13¾     | 1                     | 65¼     | 20        | 1 in 264     | Ascending                | Somersetshire Coal Canal.           |
| 2                   | 39½     |                       | 25¾     |           |              | Level                    |                                     |
| 3                   | 16¾     |                       | 57¼     | 9·96      | 1 in 530     | Descending               |                                     |
| 4                   | 24      | 1                     | 7¼      |           |              | Level                    | Near Frome River.                   |
| 11                  | 71      | 7                     | 47      | 13·40     | 1 in 394     | Ascending                |                                     |
| 12                  | 44      |                       | 53      | 13·60     | 1 in 388     | Ascending                | N. Parade, Frome.                   |
| 13                  | 4       |                       | 40      | 18        | 1 in 293     | Ascending                | T. P. Road, Frome to Warminster.    |
| 23                  | 38¼     | 10                    | 34¼     | 18·33     | 1 in 288     | Ascending                | Summit.                             |
| 23                  | 47      |                       | 8¾      |           |              | Level                    |                                     |
| 26                  | 2½      | 2                     | 35½     | 13·76     | 1 in 396     | Descending               | T.P. Road, Wincanton to Castle Cary |
| 29                  | 42½     | 3                     | 40      | 3·49      | 1 in 1511    | Ascending                |                                     |
| 31                  | 50¼     | 2                     | 7¾      |           |              | Level                    |                                     |
| 39                  | 4¾      | 7                     | 34½     | 17·98     | 1 in 294     | Descending               |                                     |
| 42                  | 65¾     | 3                     | 61      | 36·66     | 1 in 144     | Ascending                |                                     |
| 43                  | 51½     |                       | 65¾     | 59·32     | 1 in 89      | Ascending                |                                     |
| 44                  | 64      | 1                     | 12½     |           |              | Level                    |                                     |
| 51                  | 42      | 6                     | 58      | 26·66     | 1 in 198     | Descending               |                                     |
| 54                  | 34      | 2                     | 72      |           |              | Level                    |                                     |
| 56                  | 25      | 1                     | 71      | 36·66     | 1 in 144     | Descending               |                                     |
| 60                  | 5       | 3                     | 60      | 43        | 1 in 122     | Descending               |                                     |
| 60                  | 63      |                       | 58      |           |              | Level                    | Terminus on the Quay at Weymouth.   |



## EARTH-WORKS.

The earth-works are comparatively slight, and the cuttings and embankments appear to be well balanced.

## TUNNELS IN MAIN LINE.

| Nos. | Length.<br>Miles. Chains. | Height. | Inclination. | Location. |
|------|---------------------------|---------|--------------|-----------|
|------|---------------------------|---------|--------------|-----------|

|   |         |              |               |                 |
|---|---------|--------------|---------------|-----------------|
| 1 | .. 1 37 | .... 24 feet | .... 1 in 264 | .... Claverton. |
|---|---------|--------------|---------------|-----------------|

There are six vertical Shafts proposed, varying from 159 to 429 feet in depth.

|   |         |              |            |                     |
|---|---------|--------------|------------|---------------------|
| 2 | .. 0 14 | .... 24 feet | .... Level | .... Limpley Stoke. |
|---|---------|--------------|------------|---------------------|

The depth from summit of ground to level of rails, 100 feet.

|   |         |              |            |                 |
|---|---------|--------------|------------|-----------------|
| 3 | .. 0 19 | .... 24 feet | .... Level | .... Freshford. |
|---|---------|--------------|------------|-----------------|

One Shaft proposed, 88 feet deep.

|   |         |              |               |                  |
|---|---------|--------------|---------------|------------------|
| 4 | .. 0 15 | .... 24 feet | .... 1 in 396 | .... Hungerford. |
|---|---------|--------------|---------------|------------------|

Rails, 92 feet 5 inches below top surface.

|   |         |              |               |                       |
|---|---------|--------------|---------------|-----------------------|
| 5 | .. 1 51 | .... 24 feet | .... 1 in 198 | .... Buckland Newton. |
|---|---------|--------------|---------------|-----------------------|

There are seven vertical Shafts proposed in this Tunnel, varying from 71 to 344 feet in depth. The summit of the Hill is 416 feet 5 inches above the surface of rails.

|   |         |            |            |                    |
|---|---------|------------|------------|--------------------|
| 6 | .. 0 16 | .. 24 feet | .... Level | .. Poundbury Camp. |
|---|---------|------------|------------|--------------------|

56 feet 6 inches below top surface.

|   |         |              |            |                     |
|---|---------|--------------|------------|---------------------|
| 7 | . 0 27½ | .... 24 feet | .... Level | .... Maiden Castle. |
|---|---------|--------------|------------|---------------------|

Summit of Hill, 185 feet above rails.

|   |        |              |               |                                                   |
|---|--------|--------------|---------------|---------------------------------------------------|
| 8 | .. 1 5 | .... 24 feet | .... 1 in 144 | .... Parishes of Monkton,<br>Winterborn, & Upway. |
|---|--------|--------------|---------------|---------------------------------------------------|

There are four Shafts proposed, varying from 85 to 204 feet in depth.

## GRADIENTS, &amp;c. OF BRANCHES.

Branch from Freshford to Warminster.

| Distance from Junction with Main Line. |         | Length of each Plane. |         | Gradient. | Inclination. | Ascending or Descending. | Locations.                   |
|----------------------------------------|---------|-----------------------|---------|-----------|--------------|--------------------------|------------------------------|
| Miles.                                 | Chains. | Miles.                | Chains. | Feet.     |              |                          |                              |
|                                        | 23      |                       | 23      | 10·19     | 1 in 518     | Descending               | Near River Frome.            |
|                                        | 64      |                       | 41      |           |              | Level                    |                              |
| 1                                      | 59¾     |                       | 75¾     | 10·03     | 1 in 526     | Ascending                |                              |
| 2                                      | 57      |                       | 77¼     |           |              | Level                    | T. P. Road, near Bradford.   |
| 4                                      | 73½     | 2                     | 16½     | 98        | 1 in 529     | Ascending                |                              |
| 7                                      | 16      | 2                     | 22½     |           |              | Level                    |                              |
| 8                                      | 73½     | 1                     | 57½     | 27·35     | 1 in 193     | Ascending                | Near Road at Westbury Leigh. |
| 9                                      | 74      | 1                     | 0½      | 53·33     | 1 in 99      | Ascending                |                              |
| 12                                     | 21      | 2                     | 27      | 60·68     | 1 in 87      | Ascending                |                              |
| 13                                     | 5       |                       | 64      | 7·5       | 1 in 704     | Descending               | Terminus at Warminster.      |

In this branch there are three tunnels, amounting together, in length, to 1 mile 2 chains.



## GRADIENTS, &amp;c., OF THE OTHER BRANCHES.

The branch to Coleford is 3 miles  $3\frac{3}{4}$  chains in length, having two planes, the one 1 mile  $78\frac{1}{2}$  chains, rising 1 in 106, the other 1 mile  $5\frac{1}{4}$  chains, which is level.

The branch to Huish Colliery is  $11\frac{1}{2}$  chains in length, rising 1 in  $4\frac{1}{2}$ .

The branch from Frome to Warminster is 5 miles 45 chains in length, consisting of two planes, the one 4 miles  $19\frac{1}{2}$  chains, rising 1 in 122, the other 1 mile  $25\frac{1}{2}$  chains, falling 1 in 198.

The branch from Midford to Hallatrow Bridge is 9 miles  $60\frac{1}{2}$  chains in length, and has three planes, the first 34 chains, which is level, the second 7 miles 77 chains, rising 1 in 317, and the third 1 mile  $29\frac{1}{2}$  chains, rising 1 in 88.

The branch to Farrington Gurney is 12 miles 15 chains in length, and consists of three planes, the first 8 miles  $27\frac{1}{2}$  chains, rising 1 in 396, the second 1 mile  $33\frac{1}{2}$  chains, rising 1 in 144, and the third 2 miles 34 chains, rising 1 in 106.

The branch to Clandown is  $61\frac{1}{4}$  chains in length, and has three planes, the first of which is 38 chains in length, rising 1 in  $49\frac{1}{2}$ , the second 22 chains, rising 1 in  $8\frac{1}{4}$ , and the third  $1\frac{1}{4}$  chains in length, which is level.

The branch to Wellsway Pit is  $3\frac{1}{2}$  chains in length, having two planes, the first of which is  $3\frac{3}{4}$  chains in length, and level, and the second  $9\frac{3}{4}$  chains, rising 1 in 6.

The branch to Old Welton Pit is  $8\frac{1}{2}$  chains in length, and level.

The branch to Welton Hill Pit is 24 chains in length, and consists of two planes, the first  $6\frac{1}{4}$  chains in length, and level, and the second  $17\frac{3}{4}$  chains, rising 1 in 11.

The branch from Welton to the Wood Field is 1 mile 21 chains in length, rising 1 in 75.

The branch from Frome to Radstock is 7 miles 20 chains in length, having five planes; the first 2 miles  $22\frac{1}{2}$  chains in length, rising 1 in 106, the second 2 miles  $15\frac{1}{2}$  chains, rising 1 in 132, the third  $58\frac{3}{4}$  chains, falling 1 in 43, the fourth 1 mile  $62\frac{3}{4}$



chains, falling 1 in 106, and the fifth  $10\frac{1}{2}$  chains, which is level.

The branch from Bathampton to Limpley Stoke is 4 miles 7 chains in length, having two planes, the first 41 chains, rising 1 in 193, and the second 3 miles 46 chains, which is level.

The branch to Radstock is  $13\frac{1}{2}$  chains in length, and level.

The branches do not present any formidable earth-works, but there are several curves, having radii varying from 12 to 45 chains in length.

#### CROSSINGS OF ROADS, &c., IN MAIN LINE.

There are 17 turnpike-roads proposed to be carried over the railway, 6 turnpike roads under, 24 highways and parish roads over, and 20 highways and parish roads under, 11 occupation roads over, and three occupation roads under. The river near Waterhouse is proposed to be crossed by a bridge, 42 feet above its surface.

The River Frome is crossed 11 times, the height of the rails above the water varying from 14 to 56 feet.

The Somerset coal canal, at the point of crossing, is 10 feet under the rails. There are three streams or water-courses under, and 25 roads are proposed to be crossed on the level of the rails.

The turnpike-road from Radstock, and that from Bridport, are proposed to be diverted, and the turnpike-road in Hardway to be crossed on the level.

The height for turnpike-road arches, both above and below railway, to be 14 feet.

#### CROSSINGS OF ROADS, &c., IN BRANCHES.

There are six crossings of railway over rivers, 9 turnpike-roads over railway, 7 turnpike-roads under, and one to be diverted, 2 occupation-roads over, three occupation roads under, 18 highways and parish-roads over, 17 highways and parish-roads under, 5 tramways to be crossed on the level, and



one tramway under, one brook under. The unfinished Dorset and Somerset Canal is proposed to be passed four times over the railway, and twice under. The Kennet and Avon, and Somerset coal canals, each to be crossed over by the railway at an elevation of 10 feet above the water's surface.

There are 40 highways and parish and occupation-roads proposed to be crossed on the level.

#### REMARKS.

The whole length of the main line and branches is 118 miles  $52\frac{1}{2}$  chains. The worst gradients of the main line are in the planes inclining 1 in 89 for  $65\frac{3}{4}$  chains in length, 1 in 122 for 3 miles 60 chains, and in the two planes of 1 in 144 for 5 miles 52 chains.

The other inclined planes vary from 1 in 198 to 1 in 1511, and there are 8 miles  $60\frac{1}{2}$  chains of level.

It is evident that the planes inclining from 1 in 89 to 1 in 144 will require assistant engines.

In the branches there are several planes requiring assistant and stationary engines, unless horse power be substituted for the latter.

The whole length of tunnelling in the main line and branches is 6 miles  $26\frac{1}{2}$  chains. The longest tunnel, which is in Buckland Newton parish, is 1 mile 51 chains in length.

The difficulties presenting themselves in the execution of the long tunnels of Claverton, Buckland, and Monkton, would be very considerable, owing to the number and depth of the shafts required for their execution; instead of vertical shafts, sloping ones might be adopted, with great advantage, which would materially lessen the labour, and lighten the expense.



## BIRMINGHAM, BRISTOL, AND THAMES JUNCTION RAILWAY,

### EXTENSION TO KNIGHTSBRIDGE GREEN.

(Known as the London West End Railway.)

WILLIAM HOSKING, Esq., Engineer.

Commencing at Knightsbridge Green, this line passes between the Fulham and Kensington-roads, crossing Lancelot-place, Trevor-square, Arthur-street, Montpelier-street, Harriet-street, Montpelier-row, 3 chains to the right of Brompton-square; thence crossing the road from Earl's-court at its meeting with Barrows-walk, in Kensington parish, and continuing to within 2 chains of the Kensington canal basin on the left; thence crossing Kensington-crescent and the Hammersmith-road, 3 chains to the right of Counter Bridge; thence curving through the grounds of Messrs. Bird, Mr. Scott, and Mr. Clutterbuck, and terminating at the Uxbridge-road,  $2\frac{1}{2}$  chains to the left of Shepherd's Bush-bridge.

### GRADIENTS, &c.

Datum—Level of Coping of Kensington Canal Basin.

| Distance from<br>Knightsbridge-<br>green. |         | Length of each<br>Plane. |         | Gra-<br>dient. | Inclina-<br>tion. | Ascending or<br>Descending. | Locations.          |
|-------------------------------------------|---------|--------------------------|---------|----------------|-------------------|-----------------------------|---------------------|
| Miles.                                    | Chains. | Miles.                   | Chains. | Feet.          |                   |                             |                     |
|                                           | 13.75   |                          | 13.75   |                |                   | Level                       |                     |
|                                           | 28.75   |                          | 15.     | 16             | 1 in 330          | Descending                  |                     |
| 2                                         | 2.45    | 1                        | 53.70   | 8.38           | 1 in 630          | Descending                  |                     |
| 2                                         | 3.58    |                          | 1.13    |                |                   | Level                       |                     |
| 2                                         | 22.82   |                          | 19.24   | 8.31           | 1 in 634.92       | Descending                  |                     |
| 2                                         | 62.94   |                          | 39.67   |                |                   | Level                       | Uxbridge T.P. Road. |

### CROSSINGS OF ROADS, &c.

The ground at the Knightsbridge Terminus, is 6 feet  $5\frac{1}{8}$  above the top surface of rails.



The surface of rails is shewn in the section to be 7 feet  $6\frac{3}{8}$  ins. below Lancelot-place, 8 feet  $2\frac{1}{2}$  inches below Trevor-square, 9 feet 1 inch below Montpelier-street, which is proposed to be raised 5 feet 5 inches; 7 feet  $5\frac{1}{2}$  below Harriet-street, which is to be raised 7 feet  $\frac{1}{2}$  inch; 7 feet  $9\frac{1}{2}$  below Montpelier-row, 2 feet 6 inches below Gloucester-road, which is to be raised 12 feet; 6 feet below Barrow's-walk, 6 feet  $5\frac{1}{4}$  inches below Earl's-court-lane; 4 feet below Warwick-road, which is to be raised 10 feet, 7 feet 6 inches below the Hammersmith-turnpike-road, which is to be raised 5 feet; 4 feet  $2\frac{2}{3}$  inches below Counter's Creek Sewer; and 8 feet  $6\frac{1}{2}$  inches below the Uxbridge-road, which is to be raised 6 feet.

There are three foot-paths crossed by this intended line, and one lane, which is 7 feet  $6\frac{3}{4}$  inches above the top of rails.

#### REMARKS.

The distance by this line from Knightsbridge-green, to the Uxbridge-road, is  $2\frac{3}{4}$  miles, and 2·49 chains.

The gradients are very favourable; the greatest rise being at the rate of 16 feet in a mile, or 1 in 330.

The whole line is in cutting, averaging about 6 feet in depth, and may be executed between retaining walls, as the approach of the London and Birmingham Railway to the Euston Square Station.

The turnpike-roads and streets are to be passed over the Railway, at an elevation of 14 feet 6 inches above the top surface of rails,—from which, when the thickness of the arch and road formation over it is deducted, there will only be 12 feet clear height for the passage of locomotive engines.

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## BIRMINGHAM AND DERBY JUNCTION RAILWAY.

G. STEPHENSON, Esq. Engineer.

This line leaves the intended Birmingham and Derby Railway at an angle of  $74^{\circ}$  in the township of Bolehall, and passes 28 chains to the East of Tamworth; thence crossing the River Anker, and passing one chain to the left of the Coventry Canal, near Amington, 4 chains to the right of Rekington Arms Inn, 6 chains to the right of Alvecote Mill; thence continuing between the River Anker, and the Coventry Canal, in the parish of Shuttington, 35 chains to the left of Polesworth Church; thence intersecting the western portion of the county of Leicester in Merevale parish, and continuing nearly in a direct line to near Witherley; thence passing 26 chains to the left of Mancetter Church, 6 chains to the right of Park-house in Hartshill township, 8 chains to the left of Nuneaton, leaving Attleborough close on the right, crossing the Ashby Canal, in Bulkington parish,  $2\frac{1}{2}$  chains to the left of Marston Jabit; thence passing through Marston, Weston, Bulkington, and Barnacle townships, 4 chains to the right of Shilton Church; thence intersecting the Eastern portion of the county of the city of Coventry in Ansty parish, 24 chains to the left of Nettle-hill, 7 chains to the left of Combe-fields, nearing the Oxford Canal on the right within 2 chains in Stretton township; thence nearly in a direct line, 10 chains to the right of Newbold upon Avon Church, and curving to its junction with the London and Birmingham Railway in the parish of Rugby.

The least radius of a curve is upwards of a mile, and that at its junction with the London and Birmingham Railway.



GRADIENTS, &c.

Datum—315 feet below level of Oxford Canal, at point of crossing.

| Distance from Junction with Birmingham & Derby Railway. |         | Length of each plane. |      | Gradi-ent. | Inclina-tion. | Ascending or descending. | Locations.                                            |
|---------------------------------------------------------|---------|-----------------------|------|------------|---------------|--------------------------|-------------------------------------------------------|
| Miles.                                                  | Chains. | Ms.                   | Chs. | Feet.      |               |                          |                                                       |
| 4                                                       | 0       | 4                     | 0    | 8·50       | 1 in 621      | Ascending                |                                                       |
| 7                                                       | 8½      | 3                     | 8½   | 1·93       | 1 in 2733     | Descending               | Turnpike-road, Atherstone to Sheepy.                  |
| 8                                                       | 70      | 1                     | 61½  | 4·80       | 1 in 1098     | Ascending                | Turnpike-road, Atherstone to Hinckly.                 |
| 12                                                      | 0       | 3                     | 10   | 11·52      | 1 in 458      | Ascending                | [stone to Hinckly.                                    |
| 15                                                      | 15      | 3                     | 15   | 13·33      | 1 in 396      | Ascending                | Ashby Canal.                                          |
| 17                                                      | 62½     | 2                     | 47½  | 6·17       | 1 in 855      | Ascending                | Summit.                                               |
| 21                                                      | 8¾      | 3                     | 26¼  | 4·80       | 1 in 1098     | Descending               | Near Oxford old Canal.                                |
| 24                                                      | 13½     | 3                     | 4¾   |            |               | Level                    | Oxford Canal.                                         |
| 26                                                      | 36      | 2                     | 22½  | 5·26       | 1 in 1003     | Descending               | Junction with London and Birmingham Railway at Rugby. |

PRINCIPAL EARTHWORKS.

| Description.  | Length. |      | Greatest height<br>or depth. |    | Average height<br>or depth. |    | Locations. |                                          |
|---------------|---------|------|------------------------------|----|-----------------------------|----|------------|------------------------------------------|
|               | Ms.     | Chs. | Feet.                        |    | Feet.                       |    |            |                                          |
| Cutting.....  | 1       | 10   | .....                        | 78 | .....                       | 27 | .....      | Polesworth Parish.                       |
| Embankment.   | 2       | 0    | .....                        | 22 | .....                       | 10 | .....      | River Anker.                             |
| Cutting ..... | 0       | 79   | .....                        | 37 | .....                       | 20 | .....      | Bulkington Parish.                       |
| Cutting ..... | 0       | 70   | .....                        | 35 | .....                       | 20 | .....      | Shilton-lane.                            |
| Embankment .  | 0       | 50   | .....                        | 42 | .....                       | 36 | .....      | Old Oxford Canal.                        |
| Cutting ..... | 0       | 71   | .....                        | 44 | .....                       | 23 | .....      | Coombe-field.                            |
| Embankment .  | 1       | 0    | .....                        | 45 | .....                       | 25 | .....      | In Newbold, Bilton,<br>& Rugby parishes. |

CROSSINGS OF ROADS, &c.

The railway is intended to cross eight turnpike-roads, four over and four under ; eleven occupation roads, namely, four over and seven under ; twenty-six highways and parish-roads, thirteen over and thirteen under ; eight streams and brooks under ; the River Avon is crossed at an elevation of 45 feet above the water's surface, and again at 41 feet.

The Ashby Canal is to be passed over by the railway at an



elevation of 12 feet. The Oxford old Canal is crossed at six different points, and the Oxford new Canal, at an elevation of 12 feet.

#### REMARKS.

The whole length of this line from Tamworth to Rugby, is 26 miles 36 chains, consisting of seven inclined planes, the steepest of which is 3 miles 15 chains in length, and rises to the Ashby canal, at the rate of 13·33 feet per mile, or 1 in 396; the other planes vary from 1 in 458 to 1 in 2733; there is also one level plane 3 miles  $4\frac{3}{4}$  chains long. The gradients, therefore, are exceedingly favourable.

There are no objectionable curves; neither are there any tunnels.

The principal earth-works are set down in a tabular form, and will be found, by reference thereto, to present nothing formidable.

There are altogether 63 crossings of roads, canals, &c. requiring bridges to carry them either under or over the railway.

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### BIRMINGHAM AND DERBY RAILWAY DEVIATIONS.

PROPOSED DEVIATION, NO. 1, FROM CASTLE BROMWICH TO KINGSBURY, BOTH IN THE COUNTY OF WARWICK.

This deviation leaves the proposed Birmingham and Derby Junction Railway, 12 chains to the north of Burton-in-the-wood, in Coleshill Parish, crosses the green lanes and river Tame; thence passes 8 chains to the right of the Newlands, 8 chains to the left of Lea Marston, 8 chains to the left of



Coton Hall, 5 chains to the right of Kingsbury Mills, and 10 chains to the right of Kingsbury, where it joins the intended Birmingham and Derby Railway.

## GRADIENTS, &amp;c.

This deviation line consists of two planes, the former 3 miles 67 chains in length, and falling to near the road from Marston to Coton, at the rate of 15 feet in a mile, and the latter level for 1 mile and 35½ chains.

## PRINCIPAL EARTHWORKS.

| Description.  | Length. |          | Greatest height<br>or depth. |          | Average height<br>or depth.        |  | Location. |
|---------------|---------|----------|------------------------------|----------|------------------------------------|--|-----------|
|               | Ms.     | Chs.     | Feet.                        |          | Feet.                              |  |           |
| Embankment .. | 1       | 37 ..... | 27 .....                     | 15 ..... | Coleshill and As-<br>ton Parishes. |  |           |
| Embankment .. | 1       | 9 .....  | 23 .....                     | 20 ..... | Kingsbury Parish.                  |  |           |

## CROSSINGS OF ROADS, &amp;c.

There are two turnpike-roads proposed to be crossed over by the railway, one occupation road above, eight high-ways and parish roads, viz. four above and four below, one brook and one mill-stream under. The River Tame is 28 feet under at the first, and 23 at the second point of crossing.

DEVIATION NO. 2, COMMENCING IN TOWNSHIP OF BARNACLE AND PARISH OF BULKINGTON, AND TERMINATING AT THE LONDON AND BIRMINGHAM RAILWAY, IN THE PARISH OF RUGBY, BOTH IN THE COUNTY OF WARWICK.

This deviation leaves the Birmingham and Derby Railway 44 chains north-west of Shilton-lane, and proceeds to the right, and within 2 chains of Shilton; thence 2½ chains to the left of Nettle-hill, and within 8 chains of Brinklow Church; thence along the line of the Oxford Canal, proposed to be diverted, and continuing within 12 chains of Newbold Church,



on the left, close to the Lime-works in that parish; thence slightly curving to its junction with the London and Birmingham Railway, near Rugby Mill.

#### GRADIENTS.

This deviation consists of three planes, the first 3 miles  $34\frac{1}{2}$  chains in length, and falling to Smeeton-lane, at the rate of 11.67 feet per mile, or 1 in 452; the second level for 2 miles  $15\frac{1}{2}$  chains, to near the road from Brinklow to Rugby; and the third 3 miles and 22 chains, rising 3.66 feet in a mile, or 1 in 1441, to its junction with the London and Birmingham Railway in Rugby parish.

#### PRINCIPAL EARTHWORKS.

| Description.  | Length. |      | Greatest height<br>or depth. | Average height<br>or depth. | Locations.    |
|---------------|---------|------|------------------------------|-----------------------------|---------------|
|               | Ms.     | Chs. | Feet.                        | Feet.                       |               |
| Cutting ..... | 1       | 2    | 36                           | 22                          | Shilton-lane. |
| Embankment .  | 1       | 54   | 20                           | 18                          | Smeeton-lane. |
| Cutting ..... | 1       | 35   | 55                           | 15                          | Oxford Canal. |

#### CROSSINGS OF ROADS, &c.

There are two turnpike-roads above, two occupation-roads above, eight high-ways and parish-roads, viz. 5 above, and 3 below, one tramway and two streams under. The Oxford old Canal is crossed at twelve points, viz. six times above and six times below.

The River Avon is twice crossed; at the first point the railway is 34 feet, and at the second 38 feet below the top surface of rails.

#### DEVIATION NO. 3, COMMENCING IN THE PARISH OF POLESWORTH, AND TERMINATING IN THE PARISH OF NUNEATON.

This line slightly curves through Crendon parish, and crosses Watling-street, thence passes  $5\frac{1}{2}$  chains to the left of the



Coventry Canal, through Mancetter parish, and in a direct course to its junction with the original line in the parish of Nuneaton.

#### GRADIENTS, &c.

This deviation consists of three planes, the first, 2 miles  $\frac{1}{2}$  chain in length, rising at the rate of 2·99 feet in a mile, or 1 in 1765; the second, 1 mile  $79\frac{3}{4}$  chains, rising to near the Atherstone and Coles-hill turnpike-road, at the rate of 13·5 feet in a mile, or 1 in 391; and the third, 4 miles  $25\frac{3}{4}$  chains, rising to its junction with the original line in Nuneaton parish, at the rate of 2·54 feet in a mile, or 1 in 2074.

The principal earth-work is a cutting in Grendon, Merevale, and Mancetter parishes, 1 mile 70 chains in length, and averaging 15 feet in depth.

#### CROSSINGS OF ROADS, &c.

This line crosses four turnpike-roads which are to be carried over the railway, seven occupation-roads, viz. 4 above and 3 below; seven high-ways and parish-roads, two above and five below; one brook above, and four brooks or streams under.

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## BIRMINGHAM, DUDLEY, STOURBRIDGE, AND WOLVERHAMPTON RAILWAY.

GEORGE LEATHER, Esq., Civil Engineer.

The main line commences in a plot of ground lying between the Birmingham Canal and the Parade, at Birmingham; thence passes to the right of Camden-street, crosses Albion-street, Pope-street, and Marston-lane; thence within 9 chains of All Saints' church, on the right; crosses the Soho branch canal 5 chains to the right of the main line, passes across Winson-green and Crockett's-lane, 15 chains to the right of the canal



bridge; thence crosses Brasshouse-lane and Roebuck-lane, and proceeds within 2 chains and to the right of Kendrick's Works at West Bromwich; crosses the Birmingham canal  $2\frac{1}{2}$  chains to the left of Bromford Forge, and continues to within 4 chains to the left of the buildings at Burnt Tree, 8 chains to the left of Tipton Hall; thence through the Hamlets of Coseley and Ettingshall, 4 chains to the left of Timmins and Co.'s furnaces, and terminates at Cleveland-row, Wolverhampton.

There is a curve of 43 chains' radius in St. Martin's parish, Birmingham.

#### GRADIENTS, &c.

Datum—464 feet 5 inches below the surface-water of the Birmingham Canal or supposed Low-water mark at Liverpool.

| Distance from Birmingham. |                 | Length of each plane. | Gradient. | Inclination. | Ascending or Descending. | Locations.                     |
|---------------------------|-----------------|-----------------------|-----------|--------------|--------------------------|--------------------------------|
| Miles.                    | Chains.         | Ms. Chs.              |           | Feet.        |                          |                                |
| 1                         | $2\frac{1}{4}$  | 1 $2\frac{1}{4}$      | 4.85      | 1 in 1085    | Descending               | Soho Branch-canal.             |
| 3                         | $30\frac{1}{2}$ | 2 $28\frac{1}{4}$     | 2.79      | 1 in 1888    | Ascending                | Near Roebuck-lane.             |
| 4                         | $25\frac{1}{4}$ | 0 $74\frac{3}{4}$     | 34.28     | 1 in 154     | Ascending                |                                |
| 7                         | $14\frac{3}{4}$ | 2 $69\frac{1}{2}$     | 14.       | 1 in 375     | Ascending                |                                |
| 9                         | $14\frac{1}{4}$ | 1 $79\frac{1}{2}$     | 3.01      | 1 in 1754    | Ascending                | Summit.                        |
| 12                        | $16\frac{1}{2}$ | 3 $2\frac{1}{4}$      | 4.95      | 1 in 1065    | Descending               | Cleveland Road, Wolverhampton. |

A short tunnel is proposed at Birmingham, under Albion-street, 121 yards long, and 25 feet high.

#### EARTHWORKS.

| Description. | Length. |         | Greatest height or depth. | Average height or depth. | Locations.                  |
|--------------|---------|---------|---------------------------|--------------------------|-----------------------------|
|              | Ms.     | Chs.    | Feet.                     | Feet.                    |                             |
| Cutting..... | 1       | 74..... | 54.....                   | 22.....                  | Brass House-lane.           |
| Embankment   | 1       | 18..... | 41.....                   | 27.....                  | About 5 miles from Birming- |
| Cutting..... | 1       | 20..... | 37.....                   | 18.....                  | Cox's-lane. [ham.           |
| Cutting..... | 0       | 48..... | 50.....                   | 26.....                  | Ivy House-lane.             |

A viaduct is proposed to be constructed over the streets at Birmingham, about 220 yards in length, and averaging 20 feet in height.



## CROSSINGS OF ROADS, &amp;c.

The railway is proposed to cross eight turnpike roads, three of which are to pass over and five under ; six occupation roads, four over and two under ; twenty-three highways and parish roads, thirteen over and ten under ; eleven railways and tramways, one over and ten under ; and seven brooks, streams, &c., two over and five under.

The Soho branch canal is to be passed over the railway by an aqueduct, at an elevation of 22 feet ; the canal at Bromford, 22 feet under ; the Birmingham old canal, 16 feet 6 inches under ; and the Dudley canal, 39 feet 6 inches under. According to the Parliamentary section there is only one level crossing proposed by this line.

## BRANCH TO STOURBRIDGE.

This branch leaves the main line 6 miles 79 chains from Birmingham, at the intersection of the road from Birmingham through West Bromwich, in the parish of Tipton, and curving across the Birmingham and Dudley-road, passes the high ground north-west of Dudley by a tunnel ; thence through parishes of Dudley and Kingswinford, crossing the low ground by the River Stour, by means of a viaduct ; thence proceeding to its termination at Halfpenny Hall-lane, Stourbridge.

There is one objectionable curve in this branch, having a radius of 41 chains at its junction with the main line.

## GRADIENTS, &amp;c.

| Distance from junction with main line. |         | Length of each plane. |      | Gradients. | Inclinations. | Ascending or Descending. | Locations.                           |
|----------------------------------------|---------|-----------------------|------|------------|---------------|--------------------------|--------------------------------------|
| Miles.                                 | Chains. | Ms.                   | Chs. | Feet.      |               |                          |                                      |
| 0                                      | 30      | 0                     | 30   | 20'        | 1 in 264      | Ascending.               | Tunnel at Dudley.                    |
| 1                                      | 21      | 0                     | 71   | 5·06       | 1 in 1041     | Descending.              |                                      |
| 5                                      | 19½     | 3                     | 78½  | 50·28      | 1 in 105      | Descending.              |                                      |
| 5                                      | 40½     | 0                     | 20¾  |            |               | Level.                   | River Stour Viaduct.                 |
| 5                                      | 60¼     | 0                     | 20   | 20'        | 1 in 264      | Ascending.               | Halfpenny Hall-lane.<br>Stourbridge. |



## TUNNELS.

At Dudley a tunnel is proposed, 1562 yards long, and 23 feet high, 168 feet below the summit of ground, and 67 feet under the lowest part of the surface.

Another tunnel is proposed at Amblecote-lane, 264 yards in length, 23 feet high, and 45 feet under the general surface of ground.

## PRINCIPAL EARTHWORKS.

| Description.           | Length. |         | Greatest height    | Average height     | Locations.                    |
|------------------------|---------|---------|--------------------|--------------------|-------------------------------|
|                        | Ms.     | Chs.    | or depth.<br>Feet. | or depth.<br>Feet. |                               |
| Cutting.....           | 0       | 30..... | 68.....            | 26 . . . .         | Near junction with main line. |
| Id.....                | 0       | 53..... | 68.....            | 32.....            | West end of Dudley tunnel.    |
| Embankm <sup>t</sup> . | 1       | 10..... | 33.....            | 21.....            | Dudley & Podmore T. P. road.  |
| Cutting ....           | 1       | 18..... | 60.....            | 22.....            | Brierley Hill-road.           |

## CROSSINGS OF ROADS, &amp;c

In this branch three turnpike-roads are intended to be crossed : one to pass over the Railway and two under ; one occupation road over ; six high-ways and parish roads, five over and one under ; three tramways, two over and one under ; and one canal feeder over.

The Dudley and Selby Oak Canal to be passed over the railway by an aqueduct, at an elevation of 16 feet above the rails, and the canal basin at 25 feet 6 inches.

The River Stour to pass under the railway 86 feet below the top surface of rails, by means of a viaduct of six arches, averaging 75 feet in height.

## REMARKS.

The main line is 12 miles  $16\frac{1}{2}$  chains in length, and is divided into six planes, of which four are ascending from Birmingham, and two descending. The worst gradient in the main line is 1 in 154, or 34.28 feet per mile, for a length of  $74\frac{3}{4}$  chains. The other planes vary from 2.79 feet to 14 feet per mile, and are not objectionable.



The Stourbridge branch is 5 miles  $60\frac{1}{4}$  chains in length, and is arranged in four planes: one level for  $20\frac{3}{4}$  chains, one descending towards Stourbridge for 3 miles  $78\frac{1}{2}$  chains, at the rate of 50·28 feet per mile, or 1 in 105; two ascending at the rate of 20 feet in a mile towards Stourbridge, together 50 chains in length; and lastly, one of 71 chains in length, descending towards Stourbridge at the rate of 5·06 per mile, or 1 in 1041.

The second of these planes will require an assistant engine, if high velocities are intended on this line.

The Stourbridge terminus is on a plane rising to that place, which is advantageous for starting the engines, leaving, or stopping them on arriving at this station.

The cutting at Brass House-lane, in the main line, is the principal feature in the earthworks, and is 1 mile 74 chains in length, averaging 22 feet in depth.

The railway is proposed to be passed over the streets at Birmingham, by a viaduct 220 yards in length, and averaging 20 feet in height; and over the River Stour, by another viaduct of six arches, and averaging 75 feet in height.

Seventy-two bridges and three aqueducts will be required for carrying the railway over and under roads, canals, &c., besides the viaducts more particularly described above.

The height allowed, according to the Parliamentary Section, for passing turnpike-roads and public-roads under the railway, is 20 feet, which allows 16 feet clear height for the archways; this in most cases is sufficient.

The height allowed for carrying turnpike-roads and public-roads over the railway is 19 feet, which allows 15 feet clear height for the passage of locomotive engines.



## BIRMINGHAM AND GLOUCESTER RAILWAY.

### EXTENSION AND BRANCHES.

CAPT. W. S. MOORSOM, Engineer.

### JUNCTION WITH THE CHELTENHAM AND GREAT WESTERN RAILWAY.

This junction is proposed to be effected by a line continuing in a direct course nearly South by West from the present terminus of the Birmingham and Gloucester Railway, at the crossing of the turnpike-road from Cheltenham to Tewkesbury, and proceeding through Alstone Hamlet, joins the Cheltenham and Great Western Railway, with a curve of 45 chains' radius, near the road from Cheltenham to Gloucester.

The whole length of this junction is 1 mile  $13\frac{1}{2}$  chains, and rises to the Cheltenham and Great Western Railway, at the rate of 14.34 feet per mile, or 1 in 368.

The earth-works are too slight to require description.

The crossings consist of three roads, which are to be passed over the railway, two occupation-roads under, or on the surface of the rails, one tramway, which is to be raised 5 feet, and passed over; the Gloucester road, which is to be raised 9 feet, and carried over; and the River Chelt, which is to be passed under the railway.

### TEWKESBURY BRANCH.

This intended branch commences on the south bank of the River Severn, at Tewkesbury, and continues in a south-westerly direction for  $1\frac{1}{2}$  chains; thence crosses the River Avon close to the bridge, as also High-street and Oldbury, and proceeds nearly parallel and on the left of the turnpike-road from Tewkesbury to Ash-church, and effects its junction with the Birmingham and Gloucester Railway in Ash-church parish, by a curve of 17 chains' radius.



The length of this branch is 2 miles,  $29\frac{1}{2}$  chains, and consists of a level plane, 1 mile  $2\frac{3}{4}$  chains in length, at Tewkesbury, and an inclined plane of 1 mile  $26\frac{3}{4}$  chains in length, rising to the Birmingham and Gloucester Railway, at the rate of nearly 16 feet per mile, or 1 in 330.

The crossings consist of a lane, which is to be lowered 4 feet; a second lane, which is to be raised 10 feet and carried over the railway; three field-roads, one of which is to be passed on the level; the River Avon, which is to be passed under; besides four streets or roads at Tewkesbury, including High-street and Oldbury, all of which are to be crossed on the level.

#### WORCESTER BRANCH.

This proposed branch leaves the Birmingham and Gloucester Railway, in the hamlet of Wadborough, with a curve of 55 chains' radius, and passing 9 chains to the right of Cooksholm, 4 chains to the right of Pound-house, 7 chains to the right of Norton Church,  $6\frac{1}{2}$  chains to the right of Newlands, 4 chains to the left of Upper Batten-hall, 5 chains to the left of Middle Batten-hall, and 12 chains to the right of Lower Batten-hall, terminates on the south side of the Worcester and Crowle Turnpike-road, in the parish of St. Martin, Worcester.

The whole length of this branch is 3 miles  $77\frac{1}{2}$  chains, divided into three planes: the first rising from the Birmingham and Gloucester Railway, at the rate of 17.60 per mile, or 1 in 300, for a length of 1 mile  $11\frac{3}{4}$  chains; the second level for  $65\frac{3}{4}$  chains; and the last, descending towards Worcester, at the rate of 17 feet per mile, or 1 in 310.

The cutting at junction with main line is 1 mile 11 chains in length, and averages 17 feet in depth.

The London and Worcester Turnpike-road is proposed to be raised 20 feet, and carried over the railway; there are two other roads to be crossed, one over and one under, besides four field-roads, and one brook.



## REMARKS.

The steepest gradient is 17·60 feet per mile, or 1 in 300, in the Worcester Branch, but is not objectionable; there is another gradient of nearly the same proportion, viz. 17 feet per mile, also in the Worcester Branch; the remaining gradients are very favourable.

The worst curve is at the junction of the Tewkesbury Branch with the main line, having a radius of only 17 chains.

The height allowed for public-roads over the railway, is 16 feet, which, if 2 feet 6 inches be allowed for the arch and road formation, leaves only 13 feet 6 inches, for the extreme height in the clear of the railway arch.

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## BISHOP AUCKLAND AND WEARDALE RAILWAY.

THOMAS STOREY, Esq., Engineer.

This line commences at the Stockton and Darlington Railway, and runs in a north-westerly direction, nearly parallel with the Black Boy branch, crossing the bend of the road from South Church to Eldon, in the township of St. Andrew Auckland; thence passing to the north of Holdforth, and within 6 chains South of the gas works at Bishop Auckland; thence continuing south of Escomb, and within 10 chains to the north of Woodside, beyond which the branch diverges to Crook; the main line then continues to within 5 chains north of Holme, close to the bend of the river Wear, in the township of Witton-le-Wear, and thence crossing the river, keeps on the north side thereof; thence within 10 chains south of Garth, 10 chains south of Macneil, within 8 chains south-west of Har-



perley ; thence continuing parallel with the river, crosses it again in the parish of Wolsingham, within 4 chains of the bridge, leaving Ashes and Landieu on the south ; thence continuing to Broadwood, where the Bishopley branch goes off, and passing by the limekilns to its termination at Frosterley.

#### CURVES.

There are six curves of  $\frac{1}{2}$  a mile radius, one of  $\frac{3}{8}$  of a mile, and one of 35 chains.

#### GRADIENTS, &c.

Datum—High Water line, ordinary Spring Tides at Guage Mark, Stockton.

| Distance from Stockton and Darlington Railway. |                  | Length of each plane. |                  | Gradient. | Inclination. | Ascending or Descending. | Location. |
|------------------------------------------------|------------------|-----------------------|------------------|-----------|--------------|--------------------------|-----------|
| Miles.                                         | Chains.          | Ms.                   | Chs.             | Feet.     |              |                          |           |
|                                                | 13 $\frac{3}{4}$ |                       | 13 $\frac{3}{4}$ | 21·36     | 1 in 247     | Ascending                |           |
| 2                                              | 73 $\frac{1}{2}$ | 2                     | 59 $\frac{3}{4}$ | 21·12     | 1 in 250     | Descending               |           |
| 3                                              | 71               |                       | 77 $\frac{1}{2}$ | 9·90      | 1 in 533     | Ascending                |           |
| 5                                              | 35               | 1                     | 44               | 9·68      | 1 in 545     | Descending               |           |
| 6                                              | 74               | 1                     | 39               | 3·97      | 1 in 1328    | Descending               |           |
| 9                                              | 45 $\frac{1}{2}$ | 2                     | 51 $\frac{1}{2}$ | 11·73     | 1 in 450     | Ascending                |           |
| 16                                             | 24               | 6                     | 58 $\frac{1}{2}$ | 30·34     | 1 in 174     | Ascending                | Terminus. |

There is a tunnel proposed under the Black Boy branch railway, 61 chains long, and 23 feet 9 inches high.

#### PRINCIPAL EARTHWORKS.

The principal earthworks are, the cutting at the west-end of tunnel, 42 chains in length, and averaging about 27 feet in depth ; the River Gaunless embankment, 17 chains in length, and averaging about 38 feet in height ; River Wear embankment, at Wooton-le-Wear, 1 $\frac{1}{4}$  miles in length, and averaging about 25 feet in height, the cutting beyond 45 chains in length, and averaging about 35 feet in depth ; the River Wear embank-



ment in the parishes of St. Andrew, Auckland, and Wolsingham, upwards of 4 miles in length, and averaging about 12 feet in height; and two cuttings in the parish of Wolsingham, together upwards of  $1\frac{1}{2}$  miles in length, and averaging about 16 feet in depth.

#### CROSSINGS OF ROADS, &c.

Two turnpike roads are proposed to be crossed by the railway, one to pass under the other over; five highways and public roads, two to pass over and three under; nine occupation roads, six over and three under; thirteen brooks, streams, &c., two over and eleven under. The River Gaunless to pass 76 feet under the railway, and the River Wear at three different places.

#### CROOK BRANCH.

This branch pursues a course a little to the west of north, passing by Howden and High Bitch-burn, the former being on the west, and the latter on the east, and terminates at Crook, in the parish of Brancepeth; it is 3 miles 16 chains in length, of which  $63\frac{1}{2}$  chains is level, 1 mile  $5\frac{1}{2}$  chains rising 1 in 194, or 27·21 feet per mile, and 1 mile 27 chains, rising 1 in 44, or 120 in a mile.

The only earthwork worthy of notice in this branch is contiguous to the main line, and is  $\frac{3}{4}$  of a mile in length, its greatest height being about 62 feet, and average height about 40 feet.

#### BISHOPLEY BRANCH.

The Bishopley branch pursues the general direction of Bollihope-burn, and crosses it about  $\frac{3}{4}$  of a mile from its junction with the main line; it is 1 mile 13 chains in length, and rises 1 in 47, or 112 feet in a mile. There are two unfavourable curves in this branch, one of about 15 chains, and the other 7 chains' radius.



In the Bishopley branch there is one highway to be raised 18 feet, and passed over the railway, one occupation road over, and one brook under.

## REMARKS.

The whole length of the main line and branches is 20 miles 53 chains. The worst gradient in the main line is 30·34 feet per mile, or 1 in 174, for 6 miles 58½ chains in length. The other planes of the main line vary from 1 in 247 to 1 in 1328.

The Bishopley branch rises 1 in 47, and has two unfavourable curves.

In the Crook branch the worst gradient is 120 feet in a mile, or 1 in 44, for 1 mile and 27 chains in length.

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BOLTON AND PRESTON RAILWAY.

J. U. RASTRICK, Esq., Civil Engineer.

This line commences on the south-east quay of the Lancaster Canal, at Preston, crosses Fishergate, and proceeds to the River Ribble, which it crosses at 16 chains' distance from the bridge, and 29 chains from the North Union Railway bridge, over the same river; thence continues through the township of Walton-in-le-dale, and follows the line of the tram-road, which takes its course to the summit of the Lancaster Canal, the main line passing by a tunnel under Clayton Green; within 12 chains west of the Dog Inn, crosses the River Lostock, and thence passes through the print-works at Whittle, within 8 chains west of St. George's Church, Chorley, 15 chains east of Yarrow Bridge, crossing the Lancaster Canal, 13 chains to the east of Yarrow Bridge Inn, thence parallel with the Lancaster Canal for about  $\frac{3}{4}$  of a mile, within 17 chains north-east of Adlington, 4 chains south-west of Hyton Bleach-works,



thence passing between Blackrod and the River Douglas, within  $2\frac{1}{2}$  chains of the latter, thence south of Red Moss, within 14 chains of Lostock Mill, passing Morris fold, thence pursuing a north-easterly course, within 5 chains south of Shude Hill, 11 chains south-east of Riley's, then crossing the Middle Brook at five different points, close to Lady Bridge, and passing to Gilnow Bleach-works, 13 chains north-west of Chamber Hall, and crossing School-street, Moor-lane, Union-street, Great Moor-street, Newport-street, Byng-street, terminates at Bradford-square, Bolton, where it is intended to join the Manchester and Bolton Railway.

#### CURVES.

The objectionable curves in this line are, one near the River Ribble, of 14 chains' radius, and one at the Bolton Terminus, of 25 chains' radius.

#### GRADIENTS, &c.

Datum—Low water-line in the River Mersey, at Liverpool, which is 79 feet 4 inches below the level of the Lancaster Canal at Preston.

| Distance from Preston. |                 | Length of each plane. |                 | Gradi-ent. | Inclina-tion. | Ascending or Descending. | Location.                                                    |
|------------------------|-----------------|-----------------------|-----------------|------------|---------------|--------------------------|--------------------------------------------------------------|
| Miles.                 | Chains.         | Ms.                   | Chs.            | Feet.      |               |                          |                                                              |
| 0                      | 47              | 0                     | 47              | 5·10       | 1 in 1034     | Descending               | East side of River Ribble.                                   |
| 6                      | 46              | 5                     | 79              | 35·20      | 1 in 150      | Ascending                | To Lancaster Canal.<br>Turnpike-road, Chorley to Bolton.     |
| 9                      | $27\frac{3}{4}$ | 2                     | $61\frac{3}{4}$ | 9·75       | 1 in 542      | Ascending                |                                                              |
| 10                     | $19\frac{1}{4}$ | 0                     | $71\frac{1}{2}$ | 10·        | 1 in 524      | Descending               |                                                              |
| 14                     | $40\frac{3}{4}$ | 4                     | $21\frac{1}{2}$ | 11·94      | 1 in 442      | Ascending                | To Back Newport-st.<br>Level of Manchester & Bolton Railway. |
| 16                     | 68              | 2                     | $27\frac{1}{4}$ | 12·39      | 1 in 426      | Descending               |                                                              |
| 19                     | $51\frac{3}{4}$ | 2                     | $63\frac{3}{4}$ | 8·94       | 1 in 590      | Descending               |                                                              |
| 19                     | $63\frac{1}{2}$ | 0                     | $11\frac{3}{4}$ |            |               | Level                    |                                                              |

There is one tunnel in the parish of Leyland, 690 yards long, 25 feet high, and 93 feet below summit of ground.



## EARTHWORKS.

The principal earthworks consist of the River Ribble embankment, which is 3 miles in length, averaging 28 feet in height, and two cuttings, the one 69 chains in length, and averaging 26 feet in depth, the other 64 chains in length, and averaging 28 feet in depth.

## CROSSINGS OF ROADS, &amp;c.

The crossings consist of three turnpike-roads, two to be passed over and one under the railway; thirty-three highways and parish roads, twenty-five over and eight under; fourteen occupation roads, six over and eight under; twenty foot-paths, seven over, and thirteen under; thirty-one streams, brooks, &c., four over, and twenty-seven under. The River Ribble is 64 feet under; the Lancaster Canal is twice crossed, first at an elevation of 9 feet 8 inches above the water's surface, and secondly, at 15 feet 8 inches. The Bolton and Leigh Railway is 18 feet 10 inches above this intended line, and there are two roads proposed to be crossed on the level.

## BRANCH TO BOLTON AND LEIGH RAILWAY.

This branch is 19 miles 59 chains from Preston, and 29 chains in length. It consists of two planes, the first  $13\frac{3}{4}$  chains long, which is level, and the last  $15\frac{1}{4}$  chains in length, and rising 1 in 30, or 176 feet in a mile, to its junction with that railway.

This branch is in cutting, which averages about 15 feet in depth.

The crossings consist of Newport-street and Crooke-street, at Bolton, both of which are above the surface of the intended railway.

## REMARKS.

The whole length of this line is 19 miles  $63\frac{1}{2}$  chains, and consists of eight planes, of which one is level for  $11\frac{3}{4}$  chains,



and the rest inclining, from 1 in 150 to 1 in 1034. The worst gradient is 35·20 feet per mile, or 1 in 150, for 5 miles and 79 chains in length.

There is one tunnel, 690 yards long, and two objectionable curves.

The number of bridges required for carrying roads, canals, streams, &c., under and over the railway, is 105.

The height allowed for bridges to carry the railway over roads is 16 feet, and to carry roads under the railway 15 feet, from surface of rails to that of road.

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## BRECON AND MERTHYR TYDVIL RAILWAY.

EDWARD POWELL, Esq. Civil Engineer.

This line is proposed to commence at Merthyr Tydvil, at the intended Taaf Vale Railway Station, thence passing to the Pen y Darren Iron works, 28 chains to the left of Dowlais iron works, 2 chains to the left of Ivor Arms public house, close on the right of Blaen y garth Quarry, about  $\frac{1}{4}$  of a mile to right of Castle Morlais, 5 chains to right of Tyler Bont, near which it enters the county of Brecon ; thence close to Abercriban, 3 chains to left of Brin-sac, 5 chains to the left of Tyn y Wayn, close on the left of Dolygare, 1 chain to left of Dan yr Alli ; thence through Briny Glucian Mountain by a tunnel 1430 yards long, and 813 feet below its summit ; thence quickly curving towards, and passing within 4 chains to the left of Glynder ; thence 5 chains to the left of Ynisport, 10 chains to the left of Capel Collwng, 3 chains to the left of Pentre, 4 chains to the left of Flynnon Wen, close on the right of Rhydibine, and thence within  $\frac{1}{2}$  a chain on the right of Llynbedw ; thence 8



chains to the left of Aberclydack village, 10 chains to the left of Cue, 3 chains to the left of Caethinog, 12 chains to the left of Derwinygroes, 6 chains to the left of Pencelli Castle, 6 chains to the right of the vicarage,  $1\frac{1}{2}$  chains to the left of Pencelli Farm, thence running parallel with the canal for about  $\frac{5}{8}$ ths of a mile, passing Llanfrynach, 17 chains to the left of Maesyderwin, 8 chains to the left of Abercundrig; thence again parallel with the canal, passing between it and the river Usk, to its termination at Brecon.

#### CURVES.

There are several very sharp curves in this line, as may naturally be expected in this mountainous country.

#### GRADIENTS, &c.

The whole length of this line is 19 miles 23 chains, and consists of seven planes: the first, 78 chains in length, rising 1 in 22, or 240 feet in a mile; the second, 2 miles in length, rising 1 in 125, or 42·24 feet per mile; the third, 2 miles, 50 chains, falling 1 in 192, or 27·50 per mile; the fourth, 65 chains, falling 1 in 107, or 49 feet in a mile; the fifth, 75 chains in length, falling 1 in 38, or 139 feet in a mile; the sixth, 10 miles in length, falling at the rate of 1 in 150, or 35 feet in a mile; and the last falling 1 in 1023, or 5 feet in a mile for a length of 1 mile 75 chains.

There are four roads proposed to be crossed on the level, and fourteen brooks under.

The Morlais Brook Embankment is the principal feature in the earth-works, and is  $\frac{1}{2}$  a mile long, 70 feet high above the brook, and averages 40 feet in height.

The River Usk is proposed to be crossed by a viaduct.

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## BRIGHTON AND LONDON RAILWAY.

(Known as the line without a tunnel.)

This line commences on the south side of Kennington Oval, and runs nearly parallel with the Clapham-road, crossing Dorset-street,  $9\frac{1}{2}$  chains west thereof; and skirting the west angle of Stockwell Common, crosses Paradise-row, 9 chains east of Larkhall-lane, crosses the road from London to Clapham, at Clapham Rise; passes 6 chains west of the Church in Park-road, a quarter of a mile east of Clapham Common; crossing Poynder's-road 6 chains west of Clarence-road, within 7 chains of Clapham New Park, crossing Streatham and Tooting Commons, and continuing to within a quarter of a mile of Tooting Church on the right; thence crossing the Croydon Tramroad a quarter of a mile to the right of Mitcham Church, within 2 chains to the left of the George Inn in Morden parish; thence leaving Sparrow Farm on the right, and skirting Ewell on the left; thence crossing Epsom Common, and curving to Ashted Wood-field, and intersecting Barnet Wood, 9 chains to the left of Leatherhead Church, 5 chains to the left of Norbury Park Farm-house, 10 chains to the right of Mickleham Hall; thence through the hamlet of West Humble, 3 chains to the left of the Punch-bowl Public-house, in the parish of Dorking, 10 chains to the right of Park Farm Buildings, 3 chains to the left of Golden-lane Farm; thence skirting Holmwood Common, and passing 10 chains to the left of Peter's Farm in Capel parish, 15 chains to the right of Newdigate Church, close to Green Farm, 8 chains to the right of Temple Farm, 14 chains to the left of Taylor's Barns, 5 chains to the right of Ridge Farm; thence parallel, and within about 8 chains to the left of the road from London to Broadbridge Heath, 6 chains to the right of Hill's Farm, and 6 chains to the right of Bones Hill, in Horsham parish, 5 chains to the left of Tuckman's, in West Grinstead parish, 1 chain to the right of Well-land, curving across Joule's



Field Common, 5 chains to the right of Partridge Green, 13 chains to the right of Binesbridge, crossing Bines Green in Ashurst parish, 13 chains to the right of Eaton's Farm, 13 chains to the right of Wickham Hole, 10 chains to the left of Fox Hall, crossing the River Adur, 35 chains beyond the same in Beeding parish; thence crossing the road at Beeding,  $1\frac{1}{2}$  chains to the left of Lockbarn, skirting the chalk-pit in Beeding parish, and curving between the new Church and Buckingham House, 34 chains to the left of the former, and 15 chains to the right of the latter; thence within 21 chains, and to the left of Kingston Church; thence through Portslade, Aldrington, and Hove parishes,  $\frac{1}{2}$  mile to the left of the Chalybeate; thence curving to its termination at Brighton, 37 chains to the left of Cheapside, and  $\frac{1}{4}$  mile from St. Peter's Church.

## GRADIENTS, &amp;c.

Datum—High Water at Brighton.

| Distance from<br>Kennington<br>Oval. |                 | Length of<br>each Plane |                 | Gra-<br>dient. | Inclina-<br>tion. | Ascending or<br>Descending. | Locations.                    |
|--------------------------------------|-----------------|-------------------------|-----------------|----------------|-------------------|-----------------------------|-------------------------------|
| Miles.                               | Chains.         | Ms.                     | Chs.            | Feet.          |                   |                             |                               |
|                                      | 39              |                         | 39              | 16·39          | 1 in 322          | Descending                  | Clapham-road.                 |
| 1                                    | 36              |                         | 77              | 11·42          | 1 in 462          | Ascending                   |                               |
| 4                                    | $20\frac{3}{4}$ | 2                       | $64\frac{3}{4}$ | 15·66          | 1 in 337          | Ascending                   |                               |
| 5                                    | 40              | 1                       | $19\frac{1}{4}$ | 16·09          | 1 in 328          | Descending                  |                               |
| 6                                    | 0               |                         | 40              |                |                   | Level                       |                               |
| 9                                    | 60              | 3                       | 60              | 16·            | 1 in 330          | Ascending                   | Near River Hogsmill.          |
| 11                                   | 0               | 1                       | 20              | .              |                   | Level                       |                               |
| 13                                   | 40              | 2                       | 40              | 16·            | 1 in 330          | Ascending                   | Near River Mole.              |
| 18                                   | 0               | 4                       | 40              |                |                   | Level                       |                               |
| 25                                   | 0               | 7                       | 0               | 16·            | 1 in 330          | Ascending                   | Summit.                       |
| 27                                   | 0               | 2                       | 0               | 8·             | 1 in 660          | Descending                  | Near Road to Stammer-<br>ham. |
| 34                                   | 0               | 7                       | 0               | 16·            | 1 in 330          | Descending                  |                               |
| 34                                   | 40              |                         | 40              |                |                   | Level                       | Near Road at Tower<br>Farm.   |
| 41                                   | 40              | 7                       | 0               | 16·            | 1 in 330          | Descending                  | Near West Grinstead<br>Cut.   |
| 45                                   | 40              | 4                       | 0               | 1·75           | 1 in 3017         | Descending                  | Near River Adur.              |
| 49                                   | 40              | 4                       | 0               | 3·             | 1 in 1760         | Ascending                   | Terminus at Brighton.         |
| 54                                   | 40              | 5                       | 0               | 12·            | 1 in 440          | Ascending                   |                               |
| 55                                   | 41              | 1                       | 1               | 15·80          | 1 in 334          | Ascending                   |                               |

There are no objectionable curves, the least radius of curvature being one mile.



## PRINCIPAL EARTH-WORKS.

| Description. | Length. |      | Greatest height<br>or depth. |     | Average height<br>or depth. |     | Locations.                                                    |
|--------------|---------|------|------------------------------|-----|-----------------------------|-----|---------------------------------------------------------------|
|              | Ms.     | Chs. | Feet.                        |     | Feet.                       |     |                                                               |
| Embankment   | 1       | 35   | ...                          | 30  | ...                         | 16  | London End.                                                   |
| Cutting      | ...     | 3    | 0                            | ... | 38                          | ... | Between Clapham-rd.<br>and turnpike-road<br>to Mitcham.       |
| Embankment   | 2       | 50   | ...                          | 22  | ...                         | 17  | River Wandle.                                                 |
| Embankment   | 2       | 0    | ...                          | 43  | ...                         | 22  | River Hogsmill.                                               |
| Cutting      | ...     | 1    | 60                           | ... | 67                          | ... | Between 12 and 15<br>miles.                                   |
| Embankment   | 0       | 68   | ...                          | 65  | ...                         | 37  | River Mole.                                                   |
| Embankment   | 1       | 68   | ...                          | 62  | ...                         | 30  | River Mole, between<br>18 and 21 miles.                       |
| Cutting      | ...     | 0    | 67                           | ... | 120                         | ... | Near Punch Bowl-<br>lane.                                     |
| Embankment   | 1       | 5    | ...                          | 42  | ...                         | 25  | Black Brook.                                                  |
| Cutting      | ...     | 1    | 6                            | ... | 58                          | ... | at Temple Farm.                                               |
| Embankment   | 1       | 60   | ...                          | 44  | ...                         | 18  | Between road to Ridge<br>Farm, and road to<br>Charman's Farm. |
| Embankment   | 2       | 0    | ...                          | 51  | ...                         | 30  | Horsham.                                                      |
| Cutting      | ...     | 1    | 64                           | ... | 64                          | ... | South Water.                                                  |
| Cutting      | ...     | 0    | 53                           | ... | 70                          | ... | at 44 miles.                                                  |
| Cutting      | ...     | 0    | 35                           | ... | 96                          | ... | Beeding Chalk<br>Pit.                                         |
| Cutting      | ...     | 0    | 34                           | ... | 62                          | ... | at 49 miles.                                                  |
| Embankment   | 4       | 60   | ...                          | 34  | ...                         | 18  | Between 49 and<br>55 miles.                                   |
| Cutting      | ...     | 1    | 3                            | ... | 96                          | ... | Hove Parish.                                                  |

## CROSSINGS OF ROADS, &amp;c.

This line, according to the Parliamentary section, is intended to cross seventeen turnpike-roads, three to be passed over the railway and fourteen under; thirty-seven high-ways and parish-roads, nineteen over and eighteen under; seventy occupation-roads and private carriage-roads, thirty over and forty under; five foot-paths, two over and three under; thirty-two brooks, streams, &c. two over and thirty under. The



Beeding turnpike-road is proposed to be diverted. The West Grinstead cut is 25 feet under the level of the rails. The Croydon tramway is to be passed under, 22 feet 6 inches below the rails. The River Wandle is crossed at an elevation of 24 feet above the water's surface; the River Hogsmill at 41 feet 6 inches; the River Adur 20 feet; and the Mole is thrice crossed, twice at 33, and once at 25 feet above the water's surface, at each point of crossing respectively.

#### REMARKS.

The whole length of this line from Kennington Oval to its termination at Brighton, is 55 miles 41 chains, and consists of 18 planes, eight ascending from London, six descending in the same direction, and four level. The summit is 25 miles from the London terminus, and 239 feet above its intended level. The proposed Brighton terminus is 80 feet above that of London. The inclinations are exceedingly favourable throughout; the prevailing gradient is (that which characterises the London and Birmingham Railway) about 16 feet in a mile, or one in 330, and the level planes amount in length to  $6\frac{3}{4}$  miles.

There are no tunnels, but the earth-works are consequently heavy, and form an important item in the estimate.

The bridges, culverts required for the roads, rivers, and brooks, amount to 169.



## BRISTOL AND GLOUCESTERSHIRE RAILWAY.

J. K. BRUNEL, Esq., F.R.S., Engineer.

### PROPOSED DEVIATIONS.

The first deviation commences at Clay Bottom, in the parish of St. George, Bristol, and joins the main line in Stapleton parish. By this alteration in the line, the curvature will be much improved. The whole length is 1 mile  $16\frac{1}{2}$  chains, and consists of two planes, the former rising at the rate of 75 and the latter at 53·2 feet in a mile.

The second deviation commences at Staple-hill, and extends without an inclination for 2 miles  $54\frac{1}{2}$  chains, through Mangotsfield, Bitton, Siston, and Pucklechurch, parishes.

The line is also intended to be altered near its termination at Bristol for 47 chains. This altered line is also level.

### EXTENSION TO THE CHELTENHAM AND SWINDON RAILWAY.

The proposed extension of the Bristol and Gloucestershire Railway commences at 7 miles 50 chains from Bristol, and passing 11 chains to the left of Westerleigh church, proceeds to near the coal works in that parish, crossing Lower Yate-common, and thence slightly curving to Wickwar, and passing to Charfield-green, where the road is proposed to be diverted for about  $\frac{1}{4}$  of a mile ; it is then traced through Wooton-under-Edge and Berkeley parishes, 10 chains to the left of Nubbis Ash, 6 chains to the left of Char-mead ; thence crossing Lower Cam and Lower Halmore-fields, and passing 11 chains to the left of Coaley Iron Mill, proceeds with an easy curve through Frocester, Leonard Stanley, and Stone House parishes, and joins the Cheltenham and Swindon Railway in the parish of Moreton Valence.

There are no objectionable curves in this extension.



## GRADIENTS.

| Distance from Bristol. |         | Length of each plane. |      | Gradient. | Inclination. | Ascending or Descending. | Locations.                                    |
|------------------------|---------|-----------------------|------|-----------|--------------|--------------------------|-----------------------------------------------|
| Miles.                 | Chains. | Ms.                   | Chs. | Feet.     |              |                          |                                               |
| 9                      | 24      | 1                     | 54   | 10·75     | 1 in 491     | Ascending                | End of Tunnel.                                |
| 9                      | 60      |                       | 36   |           |              | Level                    |                                               |
| 14                     | 40      | 4                     | 60   | 12·63     | 1 in 418     | Descending               |                                               |
| 17                     | 50      | 3                     | 10   | 16·       | 1 in 330     | Descending               |                                               |
| 19                     | 66      | 2                     | 16   | 11·83     | 1 in 446     | Descending               |                                               |
| 20                     | 50      |                       | 64   |           |              | Level                    | T. P. Road from Bristol to Gloucester.        |
| 21                     | 56      | 1                     | 6    | 9·31      | 1 in 567     | Descending               |                                               |
| 22                     | 16      |                       | 40   | 10·       | 1 in 528     | Ascending                | T. P. Road from Bristol to Gloucester.        |
| 23                     | 42      | 1                     | 26   | 3·77      | 1 in 1399    | Descending               |                                               |
| 26                     | 0       | 2                     | 38   | 1·61      | 1 in 3267    | Ascending                | T. P. Road from Frocester to Gloucester.      |
| 26                     | 48      |                       | 48   | 25·88     | 1 in 204     | Ascending                |                                               |
| 27                     | 30      |                       | 62   | 5·80      | 1 in 909     | Ascending                | Junction with Cheltenham and Swindon Railway. |
| 29                     | 45      | 2                     | 15   | 15·57     | 1 in 339     | Ascending                |                                               |

There is a tunnel proposed at Wickwar, 1485 yards long, 25 feet high, and 95 feet below the surface of the ground above the middle of the tunnel.

## PRINCIPAL EARTHWORKS.

| Description. | Length. |      | Greatest height or depth. |       | Average height or depth. |       | Locations.                                 |                             |
|--------------|---------|------|---------------------------|-------|--------------------------|-------|--------------------------------------------|-----------------------------|
|              | Ms.     | Chs. |                           | Feet. |                          | Feet. |                                            |                             |
| Embankment 0 | 60      | .... | 48                        | ..... | 36                       | ...   | Between 17 and 18 miles.                   |                             |
| Embankment 1 | 40      | .... | 44                        | ..... | 22                       | ...   | By Clothing Mill, between 27 and 28 miles. |                             |
| Cutting .... | 0       | 47   | ....                      | 40    | .....                    | 26    | ...                                        | Junction with Swindon Line. |

## CROSSINGS OF ROADS, &amp;c.

The crossings consist of eight turnpike roads, seven to be passed over the railway and one under; three occupation roads, one over and two under; twenty-nine highways and parish roads, seventeen over and twelve under; twenty-nine streams, brooks, &c., four over and twenty-five under; and one canal under. There is only one level road crossing according to the section.



## REMARKS.

The length of the proposed extension of this railway to the Cheltenham and Swindon line is 21 miles 75 chains, and the whole length from Bristol, 29 miles 45 chains.

The gradients are favorable, except one, which, for 48 chains, is at the rate of 25·88 feet per mile; the other planes varying from 1 in 330 to 1 in 3267.

There is one tunnel rather more than a quarter of a mile in length.

The bridges required for passing roads, &c., over and under the railway, are fifty-two in number; and of bridges and culverts for brooks, &c., twenty-nine in number.

The clear height allowed for turnpike road bridges is 16 feet, and for parish road arches, under the railway, 15 feet.

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## CARMARTHEN, KIDWELLY, AND LLANELLY JUNCTION RAILWAY.

ALFRED THOMAS, Esq., Engineer.

This line commences on the south bank of the river Towy, at the end of the proposed pier, and proceeds with a curve of 23 chains' radius, within 2 chains of St. Ishmael's church on the left, 6 chains to the right of Dan y lan, 2 chains to the left of Bertwn, 10 chains to the left of Bertwn Quay, 6 chains to the right of Penallt; thence curving across Gwendrath Fawr River, and terminates on the south bank thereof, with a curve of 25 chains' radius, 30 chains below the town of Kidwelly.

The whole length of this line is 4 miles  $\frac{9}{11}$  chains, and is nearly level.

The river Gwendrath is proposed to be crossed by a wooden drawbridge.



The cutting through the rocks, about three quarters of a mile from the river Towy, forms the principal feature in the earthworks.

The estimate for the railway and pier is £10,455.

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### CENTRAL KENT RAILWAY.

#### FROM DEPTFORD TO SANDWICH AND SAND DOWN CASTLE.

This line is proposed to join the Greenwich Railway at or near Greenwich, leaving which it crosses the Blackheath-road and Coldbath-lane, and then running parallel with Bennet-street, crossing Orchard-hill, and Ravensbourne-lane; thence proceeding to the Lewisham-road, near the bottom of Lime-kiln-hill; from this point it passes through Lewisham, Lee, Eltham, and Bexley parishes; one chain to the right of Footscray Church, thence through North Cray and Wilmington parishes, and curving within 4 chains of Gitton-hill farm, on the right, in Sutton, at Hone parish, passing through Farningham, and 7 chains to the left of Lillingstone Park,  $\frac{1}{4}$  of a mile to the left of Shoreham Church, close to the toll-bar, in the parish of Otford; thence through the parishes of Kemsing, Ightham, Wrotham, and close on the right of Park Farm-buildings, in the latter parish; thence through Ry-arsh, Offing and West Malling parishes, 4 chains to the right of St. Leonard's-street, and within 4 chains of East Malling Church, on the left; and thence crossing Bradbourne Park, and passing through Malling Wood, intersecting Allington and Boxley parishes; thence passing 12 chains to the left of Maidstone Gaol, and continuing to Newnham Court Farm, and through Debtling, Thornham, and Bearstead parishes, 14 chains to the right of Pilgrim's-road, in Hollingbourne parish, 8 chains to the left of Greenway Fostall, 13 chains to the right of the Tile Kiln in Lenham parish, 4 chains to the left of Sandway,



2 chains to the right of the windmill, in Lenham parish, crossing the eastern extremity of Charing-heath,  $\frac{1}{2}$  a chain to the left of Swan-street; thence through Charing, Westwell, Ashford, Burton Aluph, Kennington, Boughton Aluph, Wye, Codmersham, and Chilham parishes; 6 chains to the right of Chilham Mill, thence crossing the river Stour, and passing between the Deanery and Chartham Courts; thence to Whitehall, in St. Dunstan's parish, Canterbury, crossing St. Dunstan's-street, and touching on the station of the Canterbury and Whitstable Railway; crossing the river Stour, in St. Stephen's parish, and passing 2 chains to the left of Trenley Park Wood, 15 chains to the left of Stodmarsh Church; thence touching Undertree's-buildings, 5 chains to the left of Grove-hill; thence through Stodmarsh, Preston, Ash, and Sandwich parishes, and terminating at the river Stour, in the parish of Stonar.

#### OBJECTIONABLE CURVES.

|                    |                    |
|--------------------|--------------------|
| At Greenwich ..... | 26 chains' radius. |
| Lewisham .....     | 34                 |
| Maidstone .....    | 48                 |

#### GRADIENTS, &c.

Datum—Towing Path of River Medway, at Maidstone.

| Distance from Sandown Castle. |         | Length of each plane. |      | Gradient. | Inclination. | Ascending or Descending. | Locations.                                        |
|-------------------------------|---------|-----------------------|------|-----------|--------------|--------------------------|---------------------------------------------------|
| Miles.                        | Chains. | Ms.                   | Chs. | Feet.     |              |                          |                                                   |
| 7                             | 42      | 7                     | 42   | 3·98      | 1 in 1324    | Descending               |                                                   |
| 18                            |         | 10                    | 38   | 4·49      | 1 in 1176    | Ascending                |                                                   |
| 22                            | 8       | 4                     | 8    | 10·97     | 1 in 481     | Ascending                |                                                   |
| 36                            | 72½     | 14                    | 64½  | 16·24     | 1 in 325     | Ascending                | Summit.                                           |
| 47                            | 9       | 10                    | 16½  | 19·62     | 1 in 269     | Descending               | River Medway.                                     |
| 48                            | 4       |                       | 75   | 10·66     | 1 in 495     | Ascending                |                                                   |
| 50                            | 78      | 2                     | 74   | 6·83      | 1 in 772     | Ascending                |                                                   |
| 56                            | 70      | 5                     | 72   | 16·97     | 1 in 311     | Ascending                |                                                   |
| 62                            | 73      | 6                     | 3    | 5·80      | 1 in 910     | Descending               |                                                   |
| 67                            | 40      | 4                     | 47   | 12·       | 1 in 440     | Descending               |                                                   |
| 74                            | 62      | 7                     | 22   | 6·32      | 1 in 835     | Descending               |                                                   |
| 80                            | 55      | 5                     | 73   | 17·60     | 1 in 300     | Descending               | Level of Greenwich Railway at Ravensbourne River. |



## PRINCIPAL EARTHWORKS.

| Description.  | Length. |      | Greatest height<br>or depth. |       | Average height<br>or depth. |    | Locations.                                     |
|---------------|---------|------|------------------------------|-------|-----------------------------|----|------------------------------------------------|
|               | Ms.     | Chs. | Feet.                        |       | Feet.                       |    |                                                |
| Embankment 5  | 60      | .... | 33                           | ..... | ..                          | 18 | ... In Shouldon, Worth, and Stonar Parishes.   |
| Cutting ..... | 1       | 12   | ....                         | 62    | .....                       | 36 | ... St. Dunstan's, Canterbury.                 |
| Embankment 1  | 50      | .... | 27                           | ..... | ..                          | 20 | ... Thanington and Chartham.                   |
| Cutting ..... | 0       | 63   | ...                          | 86    | .....                       | 55 | ... Chilham Parish.                            |
| Embankment 0  | 74      | .... | 30                           | ..... | ..                          | 23 | ... River Stour.                               |
| Embankment 2  | 60      | .... | 38                           | ..... | ..                          | 26 | ... Godmersham, Wye, & Boughton Aluph.         |
| Cutting ..... | 3       | 16   | ....                         | 52    | .....                       | 26 | ... Westwell and Charing.                      |
| Cutting ..... | 1       | 50   | ....                         | 75    | .....                       | 34 | ... Lenham.                                    |
| Embankment 1  | 36      | .... | 50                           | ....  | ...                         | 31 | ... Harrietsham.                               |
| Cutting ..... | 2       | 68   | ....                         | 64    | .....                       | 35 | ... Thurnham, Debtling, Boxley, and Maidstone. |
| Embankment 1  | 0       | .... | 110                          | ..... | ..                          | 55 | ... River Medway.                              |
| Embankment 3  | 0       | .... | 52                           | ..... | ..                          | 30 | ... Aylesford, Ditton, and East Malling.       |
| Cutting ..... | 1       | 50   | ....                         | 34    | .....                       | 16 | ... Ryarsh.                                    |
| Cutting ..... | 4       | 40   | ....                         | 73    | ...                         | 50 | ... Wrotham.                                   |
| Embankment 3  | 0       | .... | 24                           | ..... | ..                          | 12 | ... Otford.                                    |
| Cutting ..... | 2       | 0    | ....                         | 47    | .....                       | 30 | ... Shoreham and Eynesford.                    |
| Embankment 2  | 50      | .... | 86                           | ...   | .....                       | 36 | ... River Darent.                              |
| Embankment 1  | 0       | .... | 45                           | ..... | ..                          | 30 | ... Sutton.                                    |
| Cutting . ... | 1       | 27   | ....                         | 82    | .....                       | 43 | ... Wilmington Parish.                         |
| Embankment 1  | 55      | .... | 70                           | ..... | ..                          | 58 | ... North Cray.                                |
| Cutting ..... | 2       | 0    | ....                         | 60    | .....                       | 37 | ... Bexley.                                    |
| Embankment 2  | 60      | .... | 23                           | ..... | ..                          | 17 | ... Lee, Lewisham, & Greenwich                 |

## CROSSINGS OF ROADS, &amp;c.

There are, according to the Parliamentary Section, ten turnpike roads proposed to be crossed, three to be passed over and seven under the railway ; one occupation road to be passed over ; one hundred and fifty-seven high roads and parish roads, sixty-eight to pass over and seventy-nine under ; six streams, brooks, &c., one over and five under ; and two level crossings. The railway to pass five times over the River Stour. The River Medway to be passed by a viaduct 110 feet above the water's



surface. The River Darent to pass under the railway at 84 feet, and the River Cray at 58 feet below the surface of the rails.

#### REMARKS.

The whole length of this line, from Sandown Castle to the Greenwich Railway, is 80 miles 50 chains, and consists of twelve planes, six ascending in the direction of London, and six descending. Of these, the most unfavourable is that descending to the Medway, which is 10 miles  $16\frac{1}{2}$  chains in length, and falls at the rate of 19·62 feet per mile, or 1 in 269. The rest of the gradients vary from 1 in 300 to 1 in 1324.

According to the section, the summit is 36 miles  $72\frac{1}{2}$  chains from the southern terminus, and 310 feet above the Greenwich Railway at Deptford.

There are no tunnels, but the cuttings and embankments are exceedingly long and heavy. Of these, the most formidable are the Wrotham cutting, which is  $4\frac{1}{2}$  miles in length, and averaging 50 feet in depth; and the Charing cutting, 3 miles and 16 chains in length, and averaging 21 feet in depth.

The heaviest embankments are—that at Sandwich, which is  $5\frac{3}{4}$  miles in length, and averaging 18 feet in height; the Medway embankment, 1 mile in length and 55 feet in height; that of Aylesford, 3 miles in length and 30 feet in height; the Darent embankment, 2 miles 5 furlongs in length and 36 feet in height; and, lastly, that at North Cray, 1 mile  $5\frac{1}{2}$  furlongs in length and 58 feet in height.

The Medway is proposed to be crossed by a lofty viaduct.

The number of bridges required for rivers and roads, &c., is one hundred and seventy four, exclusive of the Medway viaduct, and of culverts, for brooks, &c., six. The clear height, according to the section, for carrying turnpike roads under the railway, is 14 feet 6 inches, allowing 3 feet 6 inches from the soffite of the arch to the top of the rails.

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## CHELTENHAM, OXFORD, AND LONDON AND BIRMINGHAM UNION RAILWAY.

CAPT. W. S. MOORSOM, Engineer.

This line joins the Cheltenham and Great Western, and the Birmingham and Gloucester Railways, at the new Gloucester-road, Cheltenham, 10 chains to the left of Hatherley Court, then crosses Tivoli, Park-place, the Gloucester Tram-road, Great Norwood-street, Commercial-street, and the Bath-road, at its junction with the Commercial-road and Upper Sandford-road; thence crossing the River Chelt, and the road from Cheltenham to London, and passing through Charlton King's parish, in a direct line, and curving and re-curving through Dowdeswell-wood; thence proceeding, by a tunnel, under Sandywell Park, about  $10\frac{1}{2}$  chains to the right of Whittington Church, crossing the turnpike-road from Cheltenham to Oxford, and re-crossing it about 3 chains to the right of Andover-ford Inn, crossing the River Coln, and leaving Owdeswell Farm about 8 chains to the right; thence  $3\frac{1}{2}$  chains to the left of Frog Mill, 22 chains to the right of Clewley-wood, 28 chains to the left of Withington, 3 chains to the left of Broadwell, and passing the high ground by means of a tunnel; thence crossing Chedworth-wood and Yanworth-common, about 17 chains to the left of Foss-bridge, within 11 chains of Dennis Church on the right, 22 chains to the right of Cocklebarrow, leaving the village of Aldsworth 7 chains on the left; thence within 3 chains on the left of Barrington Downs Farm, leaving Holwell on the right, 36 chains to the left of the meeting of the Holwell and Shilton with the Lechlade and Burford roads, 6 chains to



the right of the Quarry, in Norton parish, 5 chains to the right of Grove Farm, across Witney-common ; thence crossing the roads from Crawley and Harley, at West End, 7 chains to the left of Wood-green, 13 chains to the left of Northfield Farm, 3 chains to the left of Hill Houses ; thence twice crossing the turnpike-road from Witney to Oxford, in Ensham parish, 3 chains to the right of City Farm, crossing the river Evenlode, 15 chains to the left of the Paper Mill, in Ensham parish, 10 chains to the right of Yarnton Church, crossing the Oxford Canal, 16 chains to the left of the Junction House ; thence crossing the River Charwell, in Marston parish, 4 chains to the right of Bayswater Mill, passing the ground at Stanton St. John, by means of a tunnel ; thence through Stanton and Water Perry-wood, 8 chains to the left of Water Perry-common, 8 chains to the left of Field Farm, 11 chains to the left of Brissenden Farm,  $\frac{1}{4}$  of a mile to the left of Pepper Hill Farm, 13 chains to the right of Long Crendon, crossing the River Thame in Long Crendon parish, 23 chains to the left of Scot's Grove ; thence through Haddenham, 3 chains to the left of Haddenham Mill, crossing the road from Stone to Bishopstone, 9 chains to the right of School House ; thence skirting the North Quarry, 17 chains to the right of Southwark, 5 chains to the left of the Quarry in Walton Hamlet, Aylesbury parish, 6 chains to the right of Walton, 7 chains to the left of Bedgrove ; thence crossing the road from Aylesbury to Tring, at Ashton Clifton, 14 chains to the left of the church, 7 chains to the left of Drayton Beauchamp, 4 chains to the left of Wilstone Reservoir ; 5 chains to the left of the New Reservoir, 8 chains to the right of Witstone, 7 chains to the left of Startops-end Reservoir, crossing the Grand Junction Canal, 16 chains to the right of Marsworth Church ; thence curving to its junction with the London and Birmingham Railway, between the Folly and Boulbourne-bridge, in Marsworth parish, about 1 mile 5 furlongs from Tring.



The junction-line to Oxford leaves the main line by two curved branches, uniting together and passing through the parishes of Elsfield and Headington, in a course south by west to its termination, in a plot of ground near the city of Oxford, lying between the Oxford and Marston and the London roads.

## CURVES.

The objectionable curves are, one of  $29\frac{1}{2}$  chains and two of 36 chains' radius at Cheltenham.



### GRADIENTS, &c. OF MAIN LINE.

Datum—Level of the water in Gloucester Basin, which is 180 feet below the Old Bath Road.

| Distance from Cheltenham. |                  | Length of each plane. |                  | Gradient. | Inclination. | Ascending or descending. | Locations.                                                                  |
|---------------------------|------------------|-----------------------|------------------|-----------|--------------|--------------------------|-----------------------------------------------------------------------------|
| Miles                     | Chains.          | Ms.                   | Chs.             | Feet.     |              |                          |                                                                             |
| 0                         | 11 $\frac{3}{4}$ | 0                     | 11 $\frac{3}{4}$ | 10·12     | 1 in 517     | Ascending                |                                                                             |
| 1                         | 16 $\frac{1}{4}$ | 1                     | 4 $\frac{1}{2}$  | 117·33    | 1 in 45      | Ascending                |                                                                             |
| 1                         | 21 $\frac{1}{2}$ | 0                     | 5 $\frac{1}{4}$  |           |              | Level                    |                                                                             |
| 2                         | 24               | 1                     | 2 $\frac{1}{2}$  | 176·      | 1 in 30      | Ascending                |                                                                             |
| 2                         | 43               | 0                     | 19               |           |              | Level                    |                                                                             |
| 3                         | 34               | 0                     | 71               | 20·54     | 1 in 257     | Ascending                |                                                                             |
| 3                         | 79 $\frac{1}{2}$ | 0                     | 45 $\frac{1}{2}$ | 12·02     | 1 in 439     | Ascending                |                                                                             |
| 4                         | 39               | 0                     | 39 $\frac{1}{2}$ | 15·90     | 1 in 332     | Ascending                | [cester.                                                                    |
| 4                         | 62 $\frac{3}{4}$ | 0                     | 23 $\frac{3}{4}$ |           |              | Level                    | Turnpike-rd. to Glou-                                                       |
| 5                         | 42 $\frac{1}{4}$ | 0                     | 59 $\frac{1}{2}$ | 16·50     | 1 in 320     | Descending               | Old turnpike-road,<br>Gloucester to Lond <sup>n</sup> .                     |
| 5                         | 72 $\frac{1}{2}$ | 0                     | 30 $\frac{1}{4}$ |           |              | Level                    |                                                                             |
| 7                         | 42 $\frac{1}{2}$ | 1                     | 50               | 16·       | 1 in 330     | Descending               | Road from Cassey<br>Compton to With-<br>[ington.                            |
| 7                         | 61 $\frac{3}{4}$ | 0                     | 19 $\frac{1}{4}$ | 11·78     | 1 in 448     | Ascending                |                                                                             |
| 10                        | 51 $\frac{1}{2}$ | 2                     | 69 $\frac{3}{4}$ | 15·90     | 1 in 332     | Descending               | River Coln.                                                                 |
| 11                        | 45 $\frac{1}{4}$ | 0                     | 73 $\frac{3}{4}$ | 7·05      | 1 in 748     | Descending               |                                                                             |
| 13                        | 23 $\frac{3}{4}$ | 1                     | 58 $\frac{1}{2}$ | 7·41      | 1 in 712     | Ascending                | Saltway-road.                                                               |
| 14                        | 42 $\frac{1}{2}$ | 1                     | 18 $\frac{3}{4}$ | 15·80     | 1 in 334     | Descending               | Leach Brook.                                                                |
| 15                        | 69               | 1                     | 26 $\frac{1}{2}$ | 6·39      | 1 in 826     | Descending               |                                                                             |
| 17                        | 33 $\frac{1}{4}$ | 1                     | 44 $\frac{1}{4}$ | 15·85     | 1 in 333     | Ascending                |                                                                             |
| 24                        | 52 $\frac{1}{4}$ | 7                     | 19 $\frac{1}{2}$ | 16·       | 1 in 330     | Descending               |                                                                             |
| 28                        | 3 $\frac{1}{4}$  | 3                     | 30 $\frac{1}{2}$ | 13·71     | 1 in 385     | Descending               |                                                                             |
| 29                        | 11               | 1                     | 7 $\frac{3}{4}$  | 7·14      | 1 in 739     | Descending               | Turnpike-road, Wit-<br>ney to Woodstock.                                    |
| 29                        | 58 $\frac{3}{4}$ | 0                     | 47 $\frac{3}{4}$ |           |              | Level                    |                                                                             |
| 33                        | 57               | 3                     | 78 $\frac{1}{4}$ | 16·09     | 1 in 328     | Descending               | Near River Evenlode.                                                        |
| 35                        | 36 $\frac{3}{4}$ | 1                     | 59 $\frac{3}{4}$ |           |              | Level                    |                                                                             |
| 36                        | 13 $\frac{1}{4}$ | 0                     | 56 $\frac{1}{2}$ | 16·39     | 1 in 322     | Descending               |                                                                             |
| 37                        | 32 $\frac{3}{4}$ | 1                     | 19 $\frac{1}{2}$ |           |              | Level                    |                                                                             |
| 37                        | 55               | 0                     | 23 $\frac{1}{4}$ | 16·19     | 1 in 326     | Descending               |                                                                             |
| 40                        | 12               | 2                     | 37               |           |              | Level                    | Junction with Oxford<br>branch.                                             |
| 43                        | 5 $\frac{1}{4}$  | 2                     | 73 $\frac{1}{4}$ | 16·04     | 1 in 329     | A scending               |                                                                             |
| 43                        | 21 $\frac{1}{2}$ | 0                     | 16 $\frac{1}{4}$ | 9·41      | 1 in 561     | Descending               |                                                                             |
| 45                        | 53 $\frac{1}{2}$ | 2                     | 32               | 16·14     | 1 in 327     | Descending               |                                                                             |
| 48                        | 25 $\frac{3}{4}$ | 2                     | 52 $\frac{1}{4}$ |           |              | Level                    |                                                                             |
| 49                        | 62 $\frac{1}{2}$ | 1                     | 36 $\frac{3}{4}$ | 12·69     | 1 in 416     | Ascending                |                                                                             |
| 51                        | 31               | 1                     | 48 $\frac{1}{2}$ |           |              | Level                    |                                                                             |
| 52                        | 30 $\frac{1}{2}$ | 0                     | 79 $\frac{1}{2}$ | 12·08     | 1 in 437     | Ascending                |                                                                             |
| 55                        | 63 $\frac{1}{2}$ | 3                     | 33               | 25·14     | 1 in 210     | Ascending                |                                                                             |
| 56                        | 59 $\frac{1}{2}$ | 0                     | 76               | 5·61      | 1 in 941     | Ascending                |                                                                             |
| 59                        | 40 $\frac{1}{2}$ | 2                     | 61               |           |              | Level                    | Turnpike-road.                                                              |
| 66                        | 76               | 7                     | 35 $\frac{1}{2}$ | 16·09     | 1 in 328     | Ascending                | Junction with London<br>and Birmingham<br>Railway at Old<br>Dunstable-road. |



## PRINCIPAL EARTHWORKS.

| Description.    | Length. |      | Greatest height or depth. |    | Average height or depth.                         |  | Locations. |
|-----------------|---------|------|---------------------------|----|--------------------------------------------------|--|------------|
|                 | Ms.     | Chs. | Feet.                     |    | Feet.                                            |  |            |
| Cutting . . . . | 1       | 40   | 32                        | 17 | Cheltenham.                                      |  |            |
| Cutting . . . . | 0       | 18   | 90                        | 62 | East end of Cassey Compton Tunnel.               |  |            |
| Cutting . . . . | 0       | 25   | 75                        | 40 | At road from Cassey Compton to Chedworth.        |  |            |
| Embankment      | 0       | 28   | 75                        | 56 | River Coln, near 11 miles.                       |  |            |
| Cutting . . . . | 1       | 12   | 45                        | 24 | Road from North Leach to Winson.                 |  |            |
| Cutting . . . . | 2       | 20   | 64                        | 37 | Road from Little Barrington.                     |  |            |
| Embankment      | 1       | 8    | 39                        | 24 | River Evenlode.                                  |  |            |
| Cutting . . . . | 1       | 0    | 67                        | 37 | West end of Stanton St. John Tunnel.             |  |            |
| Cutting . . . . | 0       | 46   | 70                        | 40 | East end of Stanton St. John Tunnel.             |  |            |
| Embankment      | 2       | 20   | 44                        | 20 | Stanton-wood.                                    |  |            |
| Embankment      | 1       | 37   | 33                        | 22 | Green-lane from Tring.                           |  |            |
| Cutting . . . . | 1       | 10   | 62                        | 34 | Junction with the London and Birmingham Railway. |  |            |

The extension of the line from the Cheltenham Depôt to the Cheltenham and Great Western Union Railway, is 1 mile and 50 chains in length, and rises at the rate of 26·93 feet per mile.

The western branch of the Oxford Junction from the main line is  $48\frac{1}{2}$  chains in length, and rises to the eastern branch, at the rate of 11·50 feet per mile.

The Oxford Junction line is 1 mile 71 chains in length, and descends to the proposed Oxford Depôt, at the rate of 12·50 in a mile.

## TUNNELS.

The Sandywell-park Tunnel, on a plane rising 1 in 439, is 994 yards in length, 25 feet high, and 55 feet below the surface.

The Cassey Compton Tunnel is 418 yards long, 25 feet



high, and 105 feet below the surface. It inclines at the rate of 1 in 448. The Stanton St. John Tunnel is 341 yards in length, 25 feet high, and 81 feet 9 inches below the surface of ground, and falls at the rate of 1 in 561.

#### CROSSINGS OF ROADS, &c.

According to the Parliamentary Section, twenty-three turn-pike-roads are proposed to be crossed by this railway, ten to be passed over, and thirteen under; one hundred and eighty-eight highways and parish-roads, ninety-six over, and ninety-two under; and two to be diverted; six field-roads to be crossed by the railway, one tramway, and forty-four footpaths; fifty-two streams, brooks, &c., four over, and forty-eight under, and one level crossing.

The Oxford and Banbury Canal to be passed 25 feet under the top surface of rails. The River Chelt to be passed under the railway and the Coln eight times, at depths below the rails varying from 21 to 75 feet; the Windrush to pass 42 feet under the rails, the Evenlode 30, the Charwell 33, and the Thame 36 feet.

#### REMARKS.

The whole length of the main line from Cheltenham to Tring is 66 miles and 76 chains, divided into eleven level planes, amounting in length to 14 miles and six chains; and twenty-nine planes inclining at the rate of from 1 in 30, or 176 feet per mile, to 1 in 941, or 5.61 feet per mile.

There are two planes towards the Cheltenham end of the line, which will require stationary engines; the former rises at the rate of 1 in 30 for a length of one mile and  $2\frac{1}{2}$  chains; and the latter at the rate of 1 in 45, for a mile and  $4\frac{1}{2}$  chains.

The worst locomotive plane is towards the Tring end of the line, and rises at the rate of 1 in 210, or 25.14 feet per mile, for a length of 3 miles 33 chains.



The prevailing gradient is about 16 feet per mile.

The extended line to Cheltenham rises at the rate of 26·93 feet per mile, for a length of one mile five furlongs.

The gradients of the Oxford Junction line are  $11\frac{1}{2}$  and  $12\frac{1}{2}$  feet per mile.

The tunnels are three in number, and amount in length to 1754 yards, being 6 yards less than a mile.

There are no earthworks of sufficient magnitude to require notice here, save only the cutting at the road from Little Barrington, which is 2 miles and  $\frac{1}{4}$  in length, and averages 37 feet in depth.

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## CHESTER AND BIRKENHEAD RAILWAY.

GEORGE STEPHENSON, Esq. Engineer.

This line commences on the south bank of the River Mersey, 5 chains south side of Woodside Ferry, passes with an easy curve within 3 chains east of Hamilton-square, crosses Grangelane and the pool within 7 chains west of the Trammere Hotel, passes on the west side of the Chester Turnpike-road, within 14 chains of Derby House on the east, 27 chains left of Bromborow Bridge, 7 chains east of Lower Fields, in Childer Thornton township; thence through Little Sutton and Ledsham townships, within 6 chains west of Damage, 16 chains east of Lea, and 2 chains east of Upton Hall; and from thence, slightly curving to its termination on the north side of Brookstreet, in the Parish of St. Oswald, Chester.

### CURVES.

There are no objectionable curves in this line.



## GRADIENTS, &amp;c.

Datum—Half-tide Level.

| Distance from Woodside. |                 | Length of each Plane |                 | Gradient. | Inclination. | Ascending or Descending. | Locations.                         |
|-------------------------|-----------------|----------------------|-----------------|-----------|--------------|--------------------------|------------------------------------|
| Miles.                  | Chains.         | Ms.                  | Chs.            | Feet.     | Feet.        | Level.                   |                                    |
|                         | $7\frac{3}{4}$  |                      | $7\frac{3}{4}$  |           |              |                          |                                    |
|                         | 3               |                      | $65\frac{1}{4}$ | 16.14     | 1 in 327     | Ascending.               |                                    |
| 2                       | 59              | 1                    | 66              | 10.73     | 1 in 492     | Ascending.               | Turnpike-road Neston to New Ferry. |
| 5                       | $58\frac{1}{2}$ | 2                    | $79\frac{1}{2}$ | 8.85      | 1 in 596     | Ascending.               |                                    |
| 6                       | $72\frac{1}{2}$ | 1                    | 14              | 0.70      | 1 in 7474    | Ascending.               | Turnpike-road Hooton to Wilaston.  |
| 9                       | 37              | 2                    | $44\frac{1}{2}$ | 0.86      | 1 in 6112    | Ascending.               | Summit.                            |
| 12                      | $41\frac{1}{2}$ | 3                    | $4\frac{1}{2}$  | 14.42     | 1 in 366     | Descending               | Moston Brook.                      |
| 14                      | $71\frac{3}{4}$ | 2                    | $30\frac{1}{4}$ | 3.85      | 1 in 1370    | Descending               | Brook-street, Chester.             |

The chief feature in the earth-works is a cutting extending through Eastham, Neston, Shotwick, and Backford parishes,  $4\frac{3}{4}$  miles in length, and about 13 feet in depth.

There is a tunnel proposed at Birkenhead, whose length is 350 yards, and height 18 feet.

## CROSSINGS OF ROADS, &amp;c.

The turnpike-roads proposed to be crossed by this railway, are four in number, two to be passed over and two under; twenty-six highways and parish-roads, twenty-one over and six under; four occupation-roads, three over and one under; eleven streams, brooks, &c. including the Birkenhead and Bromborow Pools.

The Dee and Mersey Canal is to be passed under the railway, 37 feet below the rails. And there is one level crossing.

## REMARKS.

The whole length of this line is 14 miles  $71\frac{3}{4}$  chains, and is arranged in one level and seven inclined planes; the level plane is at Birkenhead, and extends for seven and three quarter chains; the other planes vary in inclination, from 1 in



327, or 16·14 feet per mile, to 1 in 7474, or 8 inches in a mile. The summit is 9 miles 37 chains from Birkenhead, and rises 82 feet 1 inch from the proposed station at that place, and 53 feet 2 inches above the level of the Chester Depôt.

There is only one short tunnel.

The bridges required for roads are thirty-five, and the bridges and culverts for brooks, &c. eleven in number.

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## CHESTER AND CREWE RAILWAY.

G. STEPHENSON, Esq., Engineer.

This line is a continuation of the proposed Birkenhead and Chester Railway, joining it at Brook-street, Chester; leaving Brook-street it pursues a course north of the Chester and Ellesmere Canal, crossing it at a distance of three furlongs north-west of Christleton Bridge; it then passes 12 chains south of Rowton, 11 chains south of the Black Dog Public-house, on the road to Whitchurch, and proceeding within 17 chains south-west of Golden Nook Bridge, again crosses the Ellesmere Canal, and approaches within  $1\frac{1}{4}$  chains of the bend thereof, near Crow Nest Bridge; thence curving through Newton, Tattenhall, and Beeston Townships, and passing within 5 chains south of Beeston Bridge, 3 chains north of Bunbury Locks, 5 chains south of Wardle Bank, 6 chains north of Cholmondeston, 5 chains north of Aston Hall, 4 chains north of Copen-hall Hays, and 4 chains north of Oak Farm, joins the Grand Junction Railway at Crewe, 7 chains north of the turnpike-road from Nantwich to Sandbach, with a curve of 36 chains' radius.



## GRADIENTS, &amp;c.

Datum—113 feet below the Waste Weir of the Pond of the Ellesmere Canal  
below Christleton Lock.

| Distance from<br>Chester. |                  | Length of<br>each Plane |                  | Gra-<br>dient. | Inclina-<br>tion. | Ascending or<br>descending. | Locations.                                                           |
|---------------------------|------------------|-------------------------|------------------|----------------|-------------------|-----------------------------|----------------------------------------------------------------------|
| Miles.                    | Chains.          | Ms.                     | Chs.             | Feet.          |                   |                             |                                                                      |
| 3                         | 0                | 3                       | 0                | 13.33          | 1 in 396          | Ascending.                  | Turnpike-road from<br>Chester to Whit-<br>church.                    |
| 3                         | 59 $\frac{3}{4}$ | 0                       | 59 $\frac{3}{4}$ | 2.00           | 1 in 2628         | Ascending.                  |                                                                      |
| 4                         | 69 $\frac{1}{2}$ | 1                       | 9 $\frac{3}{4}$  | 11.73          | 1 in 450          | Ascending.                  | Middlewich & War-<br>dle Canal.<br>River Weaver.                     |
| 8                         | 60 $\frac{1}{4}$ | 3                       | 70 $\frac{3}{4}$ | 3.59           | 1 in 1464         | Ascending.                  |                                                                      |
| 11                        | 60 $\frac{1}{4}$ | 3                       | 0                | 11.00          | 1 in 480          | Ascending.                  |                                                                      |
| 15                        | 57 $\frac{1}{2}$ | 3                       | 77 $\frac{1}{4}$ | 1.25           | 1 in 4191         | Ascending.                  |                                                                      |
| 17                        | 56 $\frac{3}{4}$ | 1                       | 79 $\frac{1}{4}$ | 11.06          | 1 in 477          | Descending                  | Summit and Junc-<br>tion with Grand<br>Junction Railway<br>at Crewe. |
| 19                        | 57 $\frac{3}{4}$ | 2                       | 1                | 10.93          | 1 in 483          | Ascending.                  |                                                                      |
| 20                        | 52 $\frac{1}{2}$ |                         | 74 $\frac{3}{4}$ | 4.65           | 1 in 1139         | Ascending.                  |                                                                      |

## EARTHWORKS.

The principal earthworks are, the cutting in the parishes of St. Oswald and Christleton, which is  $1\frac{3}{4}$  miles in length, and averaging 10 feet in depth, and the Weaver embankment, about 5 furlongs in length, and 23 feet in height.

## CROSSINGS OF ROADS, &amp;c.

The crossings consist of six turnpike-roads, five to be passed over and one under the railway; nineteen roads and streets, fifteen over and four under; twelve brooks and streams, &c.; seventeen occupation roads, fourteen over and three under.

The Ellesmere Canal is twice crossed over, and once under; the Middlewich and Wardle Canal is 11 feet 8 inches, and the River Weaver 49 feet 8 inches under the rails' surface.

## REMARKS.

The whole length of this line is 20 miles  $52\frac{1}{2}$  chains, and



is divided into nine planes, having gradients varying from 13.33 feet to 1.25 feet per mile, or from 1 in 396 to 1 in 4191: the prevailing gradient is about 11 feet in a mile; the whole line, therefore, in point of inclination, is favourable; the earthworks need scarcely be mentioned. The number of bridges required for roads, canals, &c., is forty-four, besides an aqueduct for the Ellesmere Canal, and of culverts and bridges for streams and brooks, &c. twelve; the clear height allowed for arches over the railway is 14 feet. Brook-street, Chester, is proposed either to be raised 18 feet, and passed over the railway, or to pass on the level.

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### CHESTER JUNCTION RAILWAY.

JAMES WALKER, F. R. SS., L. & E. A. BURGESS, ESQRS. Engineers.

This line is intended to form a link of the grand trunk from London to Liverpool, and branches off from the Grand Junction Railway at Crewe, in the parish of Bartholmley.

It commences near Woodside Ferry on the south side of the River Mersey, and opposite to Liverpool, at the proposed northern terminus, which is in a parcel of land lying between Church-street and Chester-street; thence crossing Ivy-street, and Abbey-street, within 2 chains west of Priory-street, passes over Tranmere Pool, and within one chain of the Dock; thence crossing Tranmere Ferry Pier, and passing within 3 chains east of the Tranmere Hotel; it now crosses the turnpike-road to Chester, 4 chains to the left of Stowey-lane Gate, and cutting off the north-west angle of Gorse Cover, intersects the western portion of Cuckoo and Bromborough Woods, and passes 10 chains to the right of Greenfield Farm, across the western portion of Plumyard Wood, and 3 chains to the left of Lowfields; and from thence in a direct line to within 8 chains south-west of Backford Church, 7 chains east of Moston Bridge, through



Upton, in the Parish of St. Mary, Chester, near which the northern branch diverges to that city. It now passes near Bache Pool, within 2 chains west of Ermine Inn, 7 chains south of Littleton, 2 chains south-west of Birch Heath, 5 chains south-west of Hargrave Chapel, 5 chains east of Haxley Hall, 11 chains south-west of Pool Bank; thence within 15 chains south of the Baptist Chapel at Brassey Green, across the Ellesmere Canal, intersecting the north part of Foxey Wood, 4 chains south of Beeston Mill, running nearly parallel with the canal on the south-west side thereof; thence within 4 chains south of Bunbury Locks on the same Canal, 5 chains north of Stoke Hall, 5 chains north of the Rookery, 8 chains north of Marshfield Bank; thence passing near Coppenhall Hays, 2 chains north of Oak Farm, and with a curve of 46 chains' radius, joins the Grand Junction Railway at Crewe, 12 chains from the Nantwich and Manchester Turnpike-road. The city of Chester is approached by two branches; the northern leaves the main line at Upton, and proceeds to the north side of Kail-yard, near the Cathedral, but east of the city wall. The southern branch diverges from the main line near Ermine Inn, and with a curve of 18 chains' radius, proceeds to the Chester Dépôt.

The curve in the Chester southern branch, and that joining the Grand Junction Railway, are the most objectionable; these are, however, in positions the most favourable for curving lines, both being contiguous to stopping places.



GRADIENTS, &c.

Datum—Surface of Ellesmere and Chester Canal at Moston Bridge.

| Distance from Woodside. |                       | Length of each Plane |                  | Gradient. | Inclination. | Ascending or Descending. | Locations.                                     |
|-------------------------|-----------------------|----------------------|------------------|-----------|--------------|--------------------------|------------------------------------------------|
| Miles.                  | Chains.               | Ms.                  | Chs.             | Feet.     |              |                          |                                                |
| 7                       | 31 $\frac{1}{4}$<br>0 | 6                    | 48 $\frac{3}{4}$ | 12·05     | 1 in 438     | Level.<br>Ascending.     | Near Turnpike-road from Neston to Hooten Gate. |
| 8                       | 40                    | 1                    | 40               | 5·00      | 1 in 1056    | Ascending.               |                                                |
| 9                       | 40                    | 1                    | 0                |           |              | Level.                   |                                                |
| 11                      | 40 $\frac{1}{4}$      | 2                    | 0 $\frac{1}{4}$  | 10·00     | 1 in 528     | Descending               | Turnpike-road from Chester to Mickle Trafford. |
| 15                      | 0                     | 3                    | 39 $\frac{3}{4}$ |           |              | Level.                   |                                                |
| 18                      | 0                     | 3                    | 0                | 5·00      | 1 in 1056    | Ascending.               |                                                |
| 20                      | 0                     | 2                    | 0                |           |              | Level.                   | Summit.                                        |
| 29                      | 39 $\frac{3}{4}$      | 9                    | 39 $\frac{3}{4}$ | 8·00      | 1 in 660     | Ascending.               |                                                |
| 32                      | 40                    | 3                    | 0 $\frac{1}{4}$  | 10·00     | 1 in 528     | Descending               |                                                |
| 35                      | 55 $\frac{1}{2}$      | 3                    | 15 $\frac{1}{2}$ | 7·25      | 1 in 728     | Ascending.               | Grand Junction Railway at Crewe.               |

The northern branch to the city of Chester leaves the main line at 14 miles 16 chains from Woodside, and is 1 mile and 6 chains in length, rising from the main line at the rate of 1 in 520 or 10·15 feet per mile.

The southern branch leaves the main line at 15 miles from Woodside, and joins the northern branch at the distance of 41 chains from the main line, ascending therefrom, at the rate of 1 in 437 or 12·08 feet per mile.

The proposed tunnel at Birkenhead is 324 yards in length, and 24 feet high.

There is a viaduct proposed to cross the streets at Chester, 187 yards in length.

PRINCIPAL EARTHWORKS.

| Description. | Length. |      | Greatest height or depth. |       | Average height or depth. |       | Locations.                                           |
|--------------|---------|------|---------------------------|-------|--------------------------|-------|------------------------------------------------------|
|              | Ms.     | Chs. |                           | Feet. |                          | Feet. |                                                      |
| Cutting..... | 1       | 30   | ....                      | 49    | .....                    | 30    | Parish of Bebbington.                                |
| Cutting..... | 4       | 20   | ....                      | 23    | .....                    | 10    | In Eastham, Neston, Shotwick, and Backford Parishes. |
| Embankment   | 2       | 20   | ....                      | 34    | .....                    | 18    | At Chester.                                          |
| Embankment   | 1       | 50   | ....                      | 46    | .....                    | 28    | Waverton Parish.                                     |



## CROSSINGS OF ROADS, &amp;c.

The turnpike-roads proposed to be crossed by this railway are eleven in number, eight to be passed over and three under ; forty-four high-roads and parish roads, twenty-two over and twenty-two under ; twenty-nine occupation-roads, seventeen over and twelve under ; nineteen foot-paths ; thirty-nine brooks, streams, &c., and three level crossings.

The Ellesmere Canal is to be passed four times under, at depths below the rails' top surface, varying from 13 to 53 feet ; and the railway to pass over the River Weaver, at an elevation of 53 feet.

## REMARKS.

The whole length of this line from Woodside to Crewe is 35 miles and  $55\frac{1}{2}$  chains ; of this, 6 miles and 71 chains is level ; there are seven other planes, inclining at the rate of from 12·05 feet per mile, or 1 in 438 to 5·00 feet per mile, or 1 in 1056.

The length of the branches is 1 mile 47 chains, and the gradients thereof, 10·15, and 12·08 feet per mile,

The gradients are therefore exceedingly favourable.

The earthworks are by no means heavy, the principal being the Eastham cutting, which is  $4\frac{1}{4}$  miles in length, and averaging 10 feet in depth.

The bridges required for crossing roads, canals, &c., are one hundred and eight in number, exclusive of the Chester viaduct ; and of culverts and bridges for brooks and streams, &c., thirty-nine. The height proposed for carrying turnpike-roads under the railway is 18 feet in the clear, and 14 feet 6 inches for arches over the railway.

There is one short tunnel proposed at Birkenhead.

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## CITY OF LONDON AND RICHMOND RAILWAY.

WILLIAM LAXTON and CHARLES JOHN BLUNT, Engineers and Surveyors.

This line commences at Bankside, near the foot of Southwark Bridge, and curving across New Park-street, Emmerson-street, Great Guilford-street, to Pleasant-place, meets the direct line from Bridge-street; thence proceeding north of Messrs. Potts's vinegar manufactory, and in a direct line to Blackfriars-road, which it crosses at the end of Edward-street; thence curving across Broadwall and Cornwall-road to the Waterloo-bridge-road, which it crosses at the end of William-street; it now proceeds curving across Granby-street and Granby-place to the Westminster-road, which it crosses by the Marsh-gate; thence crossing Carlisle-street, Union-place, Saville-place, and  $2\frac{3}{4}$  chains south of Hodges's distillery, and proceeding within 2 chains of Lambeth burial ground, on the north; crossing Broad-street,  $6\frac{1}{4}$  chains north of St. Mary's chapel, leaving Vauxhall-walk on the left; thence crossing Bridge-street,  $5\frac{1}{2}$  chains from Vauxhall-bridge, and passing on the right of the Wandsworth-road, across Nine Elms-lane,  $2\frac{1}{4}$  chains to the right of the Wandsworth-road; thence passing by the Southampton Railway station, and running nearly parallel with that line as far as Falcon-lane, where the latter curves off to the left; thence passing to the left of Battersea-fields-road, near Stoney-shot, where the Hammersmith branch goes off, and running across Plough-lane,  $4\frac{1}{2}$  chains to the left of York-place-road; thence continuing to Wandsworth, and crossing the canal and the River Wandle, at that place, about  $3\frac{1}{2}$  chains to the left of the Thames; thence continuing to Putney High-street, which it crosses 11 chains to the left of Wandsworth-lane.

It now crosses the lower road from Richmond to Putney, and passing to the right, and within  $7\frac{1}{2}$  chains of the upper road,



4½ chains to the right of Peace-bridge, and crossing White Hart-lane and East Sheen-lane, 8 chains to the right of Upper Richmond-road, intersecting the King's Farm, and crossing Green-lane, continues to its termination in the road from Richmond to London, 3½ chains from Richmond-square.

The branch to Hammersmith leaves the main line, at 3 miles 35 chains from Southwark-bridge, and proceeds within 15 chains of Battersea Church on the left; then crosses the Thames and passes through the Marsh, in Fulham parish, intersects the Imperial Gas Company's premises, passing to the left of the Kensington canal, across Mr. Poupart's market garden, and 1½ chains to the left of the Lillie Arms public-house; thence crossing Counter's-creek, which is proposed to be diverted, and the Hammersmith-road, between Portland-place and Kensington-crescent, terminates in Lee's nursery ground, in Hammersmith parish.

The curve at Bankside is 18½ chains' radius, but being near the intended station, is less objectionable.

#### GRADIENTS, &c., OF MAIN LINE.

Datum—Trinity High Water Level at London.

| Distance from Southwark bridge. |         | Length of each plane. |      | Gradient. | Inclination. | Ascending or descending. | Locations.            |
|---------------------------------|---------|-----------------------|------|-----------|--------------|--------------------------|-----------------------|
| Miles.                          | Chains. | Ms.                   | Chs. | Feet.     |              |                          |                       |
| 2                               | 8½      | 2                     | 8½   | 2·37      | 1 in 2224    | Ascending                | Vauxhall-bridge-road  |
| 4                               | 12¼     | 2                     | 3¾   | 4·88      | 1 in 1080    | Descending               |                       |
| 4                               | 67¼     |                       | 55   | 17·48     | 1 in 302     | Ascending                | Plough-lane.          |
| 5                               | 48½     |                       | 61¼  | 11·75     | 1 in 449     | Descending               | River Wandle.         |
| 6                               | 24      |                       | 55½  | 24·55     | 1 in 215     | Descending               |                       |
| 8                               | 62½     | 2                     | 38½  | ·80       | 1 in 6534    | Descending               | East Sheen-lane.      |
| 9                               | 41½     |                       | 59   | 2·71      | 1 in 1947    | Ascending                | Green-lane.           |
| 10                              | 7¾      |                       | 46¼  | 15·43     | 1 in 342     | Ascending                | Terminus at Richmond. |

#### BRANCH TO HAMMERSMITH.

|   |    |   |    |       |          |            |                            |
|---|----|---|----|-------|----------|------------|----------------------------|
| 4 | 60 | 1 | 25 | 9·53  | 1 in 554 | Ascending  | Middle of Thames.          |
| 5 | 60 | 1 | 0  | 6·50  | 1 in 812 | Descending |                            |
| 6 | 0  |   | 20 | 24·00 | 1 in 220 | Descending | Terminus at Lee's Nursery. |



## REMARKS.

The whole length of the main line from Southwark-bridge to Richmond is 10 miles  $7\frac{3}{4}$  chains, and of the branch to Hammersmith, 2 miles 45 chains.

The main line is arranged in eight planes, varying in inclination from 1 in 215, or 24·55 feet per mile, to 1 in 6534, or 9 inches in a mile. The gradient of 24·55 feet per mile is only for  $55\frac{1}{2}$  chains.

The branch consists of three planes, the steepest of which is that approaching Hammersmith, which inclines at the rate of 24 feet in a mile, or 1 in 220.

As far as Wandsworth, the railway is proposed to be carried over the streets and roads by means of a viaduct, for a length of about six miles; the rest of the main line is in cutting, averaging about 9 feet in depth.

The branch to be carried across the Thames by a bridge, and continued to Hammersmith, either by a viaduct or embankment.

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## CLARENCE AND HARTLEPOOL UNION RAILWAY.

CHRISTOPHER TENNANT, Esq., Engineer.

The main line commences at the Tide Harbour bank at Hartlepool, and runs in a direct line for 14 chains, and south east of Stranton; thence curving to within  $\frac{1}{4}$  of a mile south-east of Stranton Grange, and 18 chains to the west of Golden Flats, 5 chains to the west of East Field House; thence curving in a direction nearly west by south, and continuing to its junction with the Clarence Railway in the township of Billingham.



The Seaton Carew Branch goes off near Golden Flats, and pursues an easterly course to its termination at Seaton Carew, within 25 chains of the sea.

The curves are all easy, except that at the junction of the Seaton Carew Branch with the main line, which is 24 chains' radius.

#### GRADIENTS, &c.

Datum—200 feet below the level of the Clarence Railway at point of Junction.

| Distance from<br>Clarence<br>Railway. |         | Length of<br>each Plane |      | Gra-<br>dient. | Inclina-<br>tion. | Ascending or<br>Descending. | Locations.                          |
|---------------------------------------|---------|-------------------------|------|----------------|-------------------|-----------------------------|-------------------------------------|
| Miles.                                | Chains. | Ms.                     | Chs. | Feet.          |                   |                             |                                     |
| 2                                     | 29      | 2                       | 29   | 11·02          | 1 in 479          | Descending                  | Tide Harbour bank<br>at Hartlepool. |
| 5                                     | 31      | 3                       | 2    |                |                   | Level                       |                                     |
| 7                                     | 75½     | 2                       | 44½  | 5·86           | 1 in 899          | Descending                  |                                     |

The Seaton Branch leaves the main line at 5 miles and 6 chains from the Clarence Railway, and is 1 mile 22½ chains in length, rising at the rate of 1 in 307, or 17 feet per mile.

The principal earthwork is a cutting, west of the junction with the Seaton Branch, 2¾ miles in length, and averaging about 12 feet in depth.

There are three high-ways and parish-roads proposed to be crossed by this railway, one to be passed over and two under; three occupation-roads over; seven streams under, and one level crossing.

The Hartlepool Slake is proposed to be passed over by the railway.

#### REMARKS.

The whole length of the main line is 7 miles 75½ chains, and is divided into three planes, of which one is level for 3 miles



and 2 chains, and the others inclining at the rate of 5·86 feet per mile, or 1 in 899, and 11·02 feet per mile, or 1 in 479.

The number of bridges and culverts required for roads and streams, &c. is thirteen.

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## COLLIER WHARFS' RAILWAY.

JOSEPH GIBBS, Esq.. Engineer.

A Collier Wharf is proposed to be constructed round the East side of the Isle of Dogs, from Pitcher's Dock Yard, near the eastern entrance of the south West India Dock, at Blackwall, to the Ferry House opposite Greenwich.

The railway is proposed to join the Blackwall line at a point situated midway between Three Colt-street and Gun-lane ; it then crosses Limehouse-causeway, runs parallel to Regent-street, crossing New-street, Park-street, and Garford-street, and proceeding in a direct course, crosses the West India Dock Limehouse Basin, curves between the road to the Isle of Dogs and the west end of the Export and South Docks, crosses the South Dock Limehouse Entrance, as also Robert-street and Alfred-street, proceeds across the Isle of Dogs to the intended wharf,  $14\frac{1}{2}$  chains south of the Folly House, where it is proposed to join the railway intended to run parallel with the wharf for its whole length.

The objectionable curves are one of 11 chains, and one of 26 chains' radius.

The length of this line is 2 miles and 72 chains, divided into two planes, the inclination of the former being 1 in 302, or 17 feet per mile ; and of the latter 1 in 60, or 84 feet per mile.

The railway is proposed to cross Gun-lane at an elevation of 36 feet 9 inches, West-street at 38 feet 3 inches, Lime-



house-causeway 37 feet 9 inches, Park-street 35 feet 6 inches, Garford-street 37 feet 9 inches, the Ferry-road 32 feet, the Quay of the Limehouse West India Dock Basin 31 feet 3 inches, the Quay at the entrance to the south West India Dock 26 feet 6 inches, Robert-street 33 feet 6 inches, Alfred-street 31 feet 6 inches, and the Ferry-road to Poplar at 23 feet below the top of rails.

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## COMMERCIAL RAILWAY FROM LONDON TO BLACKWALL.

### PROPOSED EXTENSION.

WILLIAM CUBITT, Esq., F.R.S.. Engineer.

This railway is proposed to be extended from the present station at the east side of the Minories to the East India Company's warehouses in Lime-street, and passes over, in its slightly-curving-course, the Minories, at 24 feet elevation, Vine-street at 26 feet, Cooper's-row at 30 feet, Savage-gardens at 31 feet, Crutched-friars at 30 feet 8 inches, French Ordinary-court at 28 feet 10 inches, London-street at 21 feet 2 inches, Mark-lane at 24 feet, Star-court at 24 feet, Fen-church-street at 24 feet, Culver-court at 24 feet 3 inches, and Lime-street at 21 feet.

The whole length of this extended line is 2030 feet, and rises to the East India House at the rate of 1 in 340, or 15.52 feet per mile. The whole is proposed to be constructed upon arches of sufficient height to preclude the necessity of altering the levels of any of the streets.

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## DEVIZES AND MELKSHAM GREAT WESTERN UNION RAILWAY.

J. K. BRUNEL, Esq., F.R.S., Engineer.

This line commences close to the town of Devizes, and passes through the parish of St. John the Baptist, and thence 8 chains to the left of Upper Fox Hanger, 2 chains to the left of Lower Fox Hanger, 10 chains to the right of New Inn, 8 chains to the right of Cray's Marsh Farm, 14 chains to the left of Tan House Farm, 8 chains to the left of Springford-lane, 7 chains to the left of Snarlton lane; thence crossing the Wilts and Berks Canal, near Langbourne-gate, and the River Avon, 13 chains to the right of Melksham; thence proceeding to its junction with the Great Western Railway, rather more than half a mile from the Avon.

A deviation line is shewn in the plan and section, which commences rather less than a mile from Devizes, and passes through the parishes of St. John the Baptist, Devizes, Potterne, and Poulshot, and joins the main line near the New Inn. The greatest deviation from the main line is about a quarter of a mile to the left.

There are two quick curves in the main line, at and near the junction with the Western Railway, one of six the other of ten chains' radius.



GRADIENTS, &c.

Datum—Level of water of Bristol Float, and 103 feet below top-water level of the Wilts and Berks Canal, at point of crossing.

| Distance from Devizes. |         | Length of each plane. |      | Gradient. | Inclination. | Ascending or Descending. | Locations.  |
|------------------------|---------|-----------------------|------|-----------|--------------|--------------------------|-------------|
| Miles.                 | Chains. | Ms.                   | Chs. | Feet.     |              |                          |             |
| 0                      | 47½     | 0                     | 47½  | 188·      | 1 in 28      | Descending               | Rowde Lane. |
| 2                      | 76¾     | 2                     | 29¼  | 29·17     | 1 in 181     | Descending               |             |
| 3                      | 54      | 0                     | 57¼  | 4·19      | 1 in 1259    | Descending               |             |
| 5                      | 22½     | 1                     | 48½  | 31·24     | 1 in 169     | Descending               |             |
| 6                      | 6½      | 0                     | 64   | 7·50      | 1 in 704     | Descending               |             |
| 6                      | 62      | 0                     | 55½  | 11·55     | 1 in 457     | Ascending                | Melksham.   |
| 7                      | 4¼      | 0                     | 22¼  | 7·19      | 1 in 734     | Descending               |             |
| 7                      | 41      | 0                     | 36¾  |           |              | Level                    |             |

PROPOSED DEVIATION LINE FROM NEAR DEVIZES.

|   |     |   |     |       |           |            |                                     |
|---|-----|---|-----|-------|-----------|------------|-------------------------------------|
| 2 | 66  | 1 | 69  | 77·64 | 1 in 68   | Descending | Melksham and Devizes turnpike-road. |
| 3 | 2¾  | 0 | 16¾ | 4·77  | 1 in 1105 | Descending |                                     |
| 3 | 12¼ | 0 | 9½  | 16·86 | 1 in 313  | Descending | Somerham-brook.                     |
| 3 | 38¾ | 0 | 26½ | 6·04  | 1 in 874  | Ascending  | Kennet and Avon Canal.              |
| 3 | 68  | 0 | 29¼ | 27·41 | 1 in 193  | Descending | Joining main line.                  |

CROSSINGS OF ROADS, &c.

The crossings consist of two turnpike-roads to be passed over the railway ; one occupation-road over ; one lane over, and one road under ; three brooks under, and five level crossings.

The River Avon to be passed under the railway, as also the Kennet and Avon, and Wilts and Berks Canals.

REMARKS.

The whole length of this line is 7 miles and 41 chains, and consists of seven inclined and one level plane, which is 36¾ chains in length. The inclinations vary from 1 in 28 to 1 in 1259.



The deviation line is 3 miles 68 chains long, and consists of five planes, varying in inclination from 1 in 68 to 1 in 1105. The first plane of the main line will require a stationary engine.

The earthworks are not heavy. The number of bridges for roads, &c., is eight, and of culverts, for brooks, three.

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## DONCASTER, NORTH MIDLAND, AND GOOLE RAILWAY.

FREDERICK SWANWICK, Esq., Acting Engineer.

This line commences at the North Midland Railway, in Swinton township, and passes over the Kilnhurst Cut, 5 chains from its junction with the Dearne and Dove canal, thence crossing the river Dun, and passing 10 chains south of Engine Farm, again crosses the river at two points, and curving on the north side thereof, passes to the south-east and within 10 chains of Warmsworth Church, and one chain of the River; then continues to the south of Doncaster, with a short branch thereto, terminating at the Horse Fair; the main line continuing south of Bennitthorpe, and within a quarter of a mile of the Race Ground, which is on the south; thence curving southward within a quarter of a mile of the Brick Kilns, in Wheatley with Sandall township, and proceeding in a straight line to the west of Stamford; thence crossing the River Want, and curving on the north side of the Knottingley and Goole Canal, within 4 chains of its bend at New Bridge, and continuing in a direct line north of the same canal, to its termination on the North Quay of the ship dock at Goole.

The objectionable curves are those of 50 chains' radius at its junction with the North Midland line, and at Sprotborough; and that of 45 chains' radius in Warmworth Township.



## GRADIENTS, &amp;c.

Datum—Line 57 feet 3 inches below surface water of the Dun Navigation, called Kilnhurst Cut.

| Distance from North Midland Railway. |         | Length of each plane. |      | Gradient. | Inclination. | Ascending or Descending. | Locations.                                       |
|--------------------------------------|---------|-----------------------|------|-----------|--------------|--------------------------|--------------------------------------------------|
| Miles.                               | Chains. | Ms.                   | Chs. | Feet.     |              |                          |                                                  |
| 0                                    | 10      | 0                     | 10   |           |              | Level                    |                                                  |
| 2                                    | 10      | 2                     | 0    | 12·       | 1 in 440     | Descending               |                                                  |
| 7                                    | 10      | 5                     | 0    | 2·        | 1 in 2640    | Descending               |                                                  |
| 9                                    | 10      | 2                     | 0    | 8·        | 1 in 660     | Descending               |                                                  |
| 15                                   | 40      | 6                     | 30   | 1·72      | 1 in 3060    | Descending               | Dun Navigation—<br>Bramworth Cut.                |
| 16                                   | 42      | 1                     | 2    | 11·70     | 1 in 451     | Descending               |                                                  |
| 18                                   | 55      | 2                     | 13   | 1·81      | 1 in 2854    | Descending               |                                                  |
| 19                                   | 76      | 1                     | 21   | 12·30     | 1 in 416     | Ascending                | Knottingley & Goole<br>Canal.                    |
| 21                                   | 10      | 1                     | 14   | 10·43     | 1 in 506     | Descending               | Bawtrey and Selby<br>Turnpike Road.              |
| 22                                   | 17      | 1                     | 7    | 3·44      | 1 in 1531    | Descending               |                                                  |
| 23                                   | 56      | 1                     | 39   | 2·02      | 1 in 2618    | Ascending                |                                                  |
| 25                                   | 22½     | 1                     | 46½  | 1·25      | 1 in 4174    | Descending               |                                                  |
| 26                                   | 14¾     | 0                     | 72¼  | 5·54      | 1 in 953     | Ascending                | Quay of Ship Dock<br>Goole, on the sur-<br>face. |

There is a deviation line shown in Cadeby Township, 2 miles 17 chains in length, and inclining at the rate of 1 in 2640.

The branch to Doncaster leaves the main line at 7 miles 48 chains from the North Midland Railway, is 1 mile and  $\frac{3}{4}$  of a chain in length, and level.

The tunnel proposed in the main line is 236 yards long, 25 feet high, and 65 feet below the surface of ground.

## PRINCIPAL EARTHWORKS.

The principal earth works consist of two embankments, one near the North Midland Railway, upwards of a mile in length, and averaging about 30 feet in height; the other, at the Goole end, about eight miles in length, and averaging 7 feet in height.

In the proposed deviation line there is a cutting, 57 chains long, and averaging about 45 feet in depth.



## CROSSINGS OF ROADS, &amp;c.

The crossings consist of six turnpike-roads, five to be passed over the railway and one under ; nineteen highways and parish-roads, sixteen over and three under ; ten occupation-roads, three over and seven under ; and six drains under. The railway to pass four times over the River Dun, once over the River Went, once over the Kilnhurst, and once over the Bramworth Cuts, the former at 30 feet 9 inches above the water's surface, the latter at 15 feet 6 inches. The Knottingley and Goole Canal also to be passed under the railway.

## REMARKS.

The whole length of the main line, and branch to Doncaster, is 27 miles and  $15\frac{1}{2}$  chains.

The gradients are very favorable, the steepest being at the rate of 12·30 feet per mile, or 1 in 416.

The earthworks are not remarkably heavy : the Goole embankment will require to be formed by excavating side trenches.

The bridges required for roads, &c., are thirty-three, and the bridges and culverts for drains six in number.

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DURHAM JUNCTION RAILWAY

THOMAS E. HARRISON, Esq., M. Inst. C. E., Engineer.

This line commences in a field abutting north on Giles' Gate, Durham, and passes 10 chains to the south of Kepier, 5 chains north of Low Grange ; thence curving to within  $17\frac{1}{2}$  chains and north of Moor-house, and within 5 chains of Woodside ; thence to Leamside, which it crosses  $5\frac{1}{2}$  chains south-east of the road from Woodside ; thence 5 chains north-west of Adventure Pit, 5 chains from Adventure Engine,  $8\frac{1}{2}$  chains east of



Plane Pit; curving to the west side of Houghton-lane Bridge, where it joins the Durham Junction Railway, into the Township of Moston.

The Houghton-le-spring branch leaves the Durham Junction Railway near Elba, and curving to the south-west, passes near the Tile Sheds, crossing the Marquis of Londonderry's Railway, within a quarter of a mile west of Lady Jane Engine; thence within 13 chains of Low Dub-mire, which is on the west, within  $2\frac{1}{2}$  chains of Bog House on the east; thence proceeding nearly in a direct line to Houghton-le-spring, and within 5 chains east of the Tile Sheds in that parish, terminates in a parcel of ground abutting north on the road to Newbottle.

The objectionable curves are, one of  $\frac{1}{4}$  mile radius in Houghton-le-spring branch at Elba; the second,  $\frac{1}{2}$  mile radius, across the Marquis of Londonderry's Railway; and, thirdly, one of 35 chains' radius, at the termination at Houghton-le-spring: the other curves are of  $\frac{3}{4}$  of a mile' radius, and upwards.

#### GRADIENTS, &c.

The length of this line, from the Durham Junction Railway to the city of Durham, is 4 miles 70·45 chains, and consists of three planes, two of which incline at the rate of 16 feet per mile, or 1 in 330; and the third is level for 10 chains.

The Houghton-le-spring Branch is 1 mile 55 chains in length, and consists of a level plane,  $39\frac{3}{4}$  chains in length, and an inclined plane, rising to Houghton-le-spring at the rate of 1 in 139, or 38 feet per mile.

#### EARTHWORKS.

The principal earthworks in the Durham Branch are, a cutting about three-quarters of a mile long, the greatest depth being 29 and the average depth 15 feet, in the parish of Houghton-le-spring; a cutting in St. Giles' parish, about three-



quarters of a mile in length, and averaging in height 10 feet: and two embankments, one in the parish of Houghton-le-spring and St. Giles, 58 chains in length, and averaging in height 14 feet; and the second, three-quarters of a mile long, at Durham, and averaging in height 15 feet.

#### CROSSINGS OF ROADS, &c.

There are four high-roads and parish-roads proposed to be crossed by this railway, three to be passed over and one under; eleven occupation-roads, five over and six under; seven foot-paths, three over and four under; two tramways under, one brook under, and one level crossing.

#### REMARKS.

The length of this line is 4 miles 70 chains; of which, 10 chains is level, and the remainder, consisting of two planes, inclining at the rate of 16 feet in a mile.

In the Houghton-le-spring branch there is nearly half a mile level, and the remainder inclining at the rate of 1 in 139.

The bridges required for the roads, &c. are twenty-five in number.

The earthworks are not particularly heavy.

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## DURHAM AND SUNDERLAND RAILWAY.

### CONTINUATION OF THE MAIN LINE TO BRANCEPETH.

THOS. E. FOSTER, Esq., Engineer.

This continuation of the main line, commences near Broomside Pit, and passing in a south-westerly direction, within 16 chains of Sherburn Hospital, near which the Whit-



well and Quarrington Branch diverges, continues to within 6 chains, and south of Shincliffe Mill; thence across the River Wear near Shincliffe, and within 7 chains of Hough Hall, which is on the south, thence curving and recurving to within 6 chains south of Moor House, terminates about 15 chains north-west of Langley Corn Mills, in the parish of Brancepeth.

The Whitwell and Quarrington Branch passes close on the east side of Whitwell Grange, west of Whitwell Pit, and within 9 chains east of Whitwell House; thence to Cassop Moor House, within 7 chains west of Hough Hall, and continues to its junction with the Clarence Railway, 25 chains to the south-west of Caxhoe Pit.

The western branch leaves the main line at the crossing of the River Wear, near Shincliffe, and extends for two miles and eight chains to its termination at Brandon.

#### GRADIENTS, &c.

The whole length of the main line is 3 miles and 402 yards, consisting of two level planes, together 50 chains long, and two inclined planes, whose gradients are 24·78 feet, and 48 feet per mile respectively.

The Whitwell and Quarrington Branch has two level planes, and four inclined planes, which vary in inclination from 1 in 31 to 1 in 120.

The Western branch is 2 miles 8 chains in length, and consists of one level plane  $9\frac{3}{4}$  chains in length, and four inclined planes varying in inclination from 1 in 42 to 1 in 256.

#### CURVES.

The objectionable curves are—one of a quarter of a mile' radius, at junction with Whitwell Branch, and one of 10 chains' radius. In the Western Branch, there are two curves, each of about a quarter of a mile' radius.

#### PRINCIPAL EARTHWORKS.

In the main line, the chief earthwork is a cutting in



St. Oswald parish, about 27 chains long, averaging about 40 feet deep and 60 feet in extreme depth.

In the Western Branch, the chief earthworks are a cutting 50 chains long, and averaging 28 feet deep, and the River Browney embankment, 25 chains long, and 38 feet high.

In the Whitwell and Quarrington Branch, the cutting near to the Clarence Railway is the chief, and averages 18 feet in height for a length of 50 chains.

#### CROSSINGS OF ROADS, &c.

The turnpike-roads to be crossed are two in number, one to be passed over the other under the railway; eleven highways and parish-roads, seven over and four under; five occupation-roads, two over and three under; and fifteen streams, brooks, &c. The river Wear is passed over by the railway at an elevation of 30 feet, and the river Browney at 36 feet above the water's surface. The Great North of England Railway is crossed by the main line, at a distance from its junction with the original line of 2 miles and 25 chains.

#### REMARKS.

The worst plane of the main line falls at the rate of 1 in 110. In the branches the gradients are by no means favourable, several of the planes being only fitted either for the stationary system, or to be worked by horse-power.

The cuttings and embankments present large sectional areas, but none of them are of great length.

The bridges for roads, &c., are twenty-one in number, and the culverts and bridges for brooks, streams, &c., fifteen in number.

The present Parliamentary line from Broomside to Durham, upwards of  $1\frac{3}{4}$  miles in length, is intended to be abandoned.

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## EASTERN COUNTIES' RAILWAY.

## PROPOSED DIVERSIONS.

JOHN BRAITHWAITE, Esq., Engineer.

## DIVERSION No. 1.

The first diversion is south of the Parliamentary line, and extends through the parish of St. Matthew, Bethnal-green, and the hamlet of Mile-end Old-town.

It is 58 chains in length, and level, and crosses the following streets, at elevations above their respective surfaces of from 18 to 27 feet: namely, Hare-marsh, Carlisle-street, Great Manchester-street, Nottingham-street, Arundel-street, Winchester-street, North-street, Dog-row, and Globe-lane.

## DIVERSION No. 2.

The second diversion is north of the Parliamentary line, and passes through the parishes of West Ham, East Ham, Wanstead, and Little Ilford, and extends from near Maryland Point to a branch of the river Roding, a distance of 52 chains, inclining at the rate of 5 feet in a mile, or 1 in 1056, and crosses the turnpike-road from Leyton to Stratford, which is to be raised 10 feet; the road from Leyton to West Ham, which is to be raised 11 feet; the road from Leyton to Forest-gate, which is to be raised 8 feet; the road to Wanstead and to Mr. Pedler's, each to be raised 6 feet; a second road to Forest Gate, which is to be raised 5 feet; and a second road to Wanstead, which is to be raised 7 feet, and severally passed over the railway: the road to Windmill Farm is to be diverted.

This diversion is in cutting, varying from 9 to 18 feet in depth, and involves a curve of a quarter of a mile' radius.



## DIVERSION No. 3.

This diversion is south of the Parliamentary line, and passes through Witham, Rivenhall, and Kelvedon parishes, in the county of Essex.

In its course, it crosses one road, which is to be diverted for 150 yards to the east, and lowered 7 feet; the road to Rivenhall, which is 18 feet below the top surface of rails; Sniveller's-lane, which is to be raised 15 feet, and Crane's-lane, which is to be raised 11 feet, and carried over the railway. The gradient is 13 feet per mile, or 1 in 406, and there is a curve of half a mile radius. The earthworks are not heavy.

## DIVERSION No. 4.

This diversion is in the hamlet of Thorpe, and parishes of Trowse, Newton, and Postwick, in the county of Norfolk, and crosses the River Yare, 30 chains to the west of the Parliamentary line, and passes north of Thorpe Common.

The crossings are, the River Yare, which is 18 feet below the top surface of rails; the road to Postwick, which is to be raised 15 feet, and a second crossing of this road, 44 feet above rails; the road to Serlingham Ferry, which is 23 feet above the top surface of rails; and four occupation-roads.

The whole length of this deviation, is 3 miles and  $33\frac{1}{2}$  chains, and is divided into three planes; the first inclining at the rate of 5 feet per mile, or 1 in 1056 for  $42\frac{1}{2}$  chains: the second level for 1 mile; and the third 7 feet per mile, or 1 in 754 for 1 mile  $71\frac{1}{2}$  chains.

This diversion is in cutting for about  $1\frac{3}{4}$  miles, and the rest in embankment; it is decidedly superior to the Parliamentary line in point of direction, avoiding an S-curve of 14 and 15 chains' radii, but involving one whose radius is 15 chains.

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## ENGLAND AND IRELAND UNION RAILWAY.

This line commences in a plot of ground contiguous to the cattle-market at Gloucester; crosses Northgate-street, Worcester-street, Hare-street, Park-street, St. Catherine's-street, and Dean-lane; thence crossing the River Severn into Alney Island, and again crossing the same River 5 chains to the Right of Perch Farm, 3 chains to the right of the River Leadon, 4 chains to the left of Marrel's End, 5 chains to the left of Half-timber-house; thence crossing the Hereford Canal, in High Leadon parish,  $3\frac{1}{2}$  chains to the left of Moat House, 4 chains to the left of Coney Burrow, 8 chains to the right of Little Malswick,  $5\frac{1}{2}$  chains to the left of Bury-bar-house, 2 chains to the left of Little Newent Town, 2 chains to the right of Conygar,  $16\frac{1}{2}$  chains to the right of Wayet, 7 chains to the left of Kilcot Inn, 11 chains to the left of Brass-fields, entering the county of Hereford in Linton parish; thence passing the high ground at Linton, by means of two tunnels, close on the right of Little Fording; thence, by means of another tunnel under the high ground, near Fiddler's Cross, 5 chains to the right of Kingston Court Farm, through Chuckley Wood; thence taking Hildersley in the line, 3 chains to the right of Alton-court, 1 chain to the left of Merivale, 6 chains to the left of Chub Hall, 9 chains to the left of Tudorville, 3 chains to the left of Dux-mere, 4 chains to the right of Lincoln, 2 chains to the left of Lower Cleeve,  $1\frac{1}{2}$  chains to the right of Cubberley; thence crossing the River Wye, 7 chains to the left of Clinstone-court, curving through Peterstow parish by means of a tunnel under the high ground, 8 chains to the right of Ash Farm, 13 chains to the right of Mount Craig, 3 chains to the left of Brelstone, 6 chains to the left of New-



court, 3 chains to the left of Yarrow Brook Mill; thence running within 4 chains on the left of the Turnpike-road to Ross and Gloucester, 7 chains to the right of Crook-field-Ash, 7 chains to the right of Ganerew-cross, and curving by means of a tunnel through the high ground in Ganerew parish; thence approaching within 2 chains of the River Wye on the left, at the boundary between Ganerew and Dixton parishes; thence passing to Monmouth, 5 chains to the left of the Gaol, crossing the River Monnow; thence to St.-Dials-Barn, by a tunnel under the high ground at this spot, 13 chains to the right of Mitchel Troy Church, close on the right of Red-House-Farm-Buildings; thence to Bourne-buildings in Cwm-carvan parish,  $2\frac{1}{2}$  chains to the right of Tal y fan, running nearly parallel, and on the left of the turnpike-road from Tregear to Monmouth, about five chains distant, 4 chains to the right of Twyn yr Argoed; thence crossing Ragland-street, and the turnpike-road from Usk, 7 chains to the right of Clitha, 16 chains to the right of Bryn gwyn Farm, close on the right of Cross Buchan, 5 chains to the right of Clytha Park, thence slightly curving to within  $9\frac{1}{2}$  chains of Llangattock-juxta-Usk Church, 4 chains to the left of Penpergwn, 4 chains to the right of the River Usk, in Hardwick parish, 4 chains to the right of Great Hardwick,  $2\frac{1}{2}$  chains to the left of Little-Hardwick,  $6\frac{1}{2}$  chains to the right of Lower Llanfoist, close on the left of Llanfoist;  $5\frac{1}{2}$  chains to the right of Upper Llanfoist; thence through Llanfoist,  $5\frac{1}{2}$  chains to the left of the Parsonage, 5 chains to the left of Penyrtod, close on the left of Cadfor; thence curving and re-curving within 8 chains of the Beaufort Arms on the left, crossing the River Clydach; thence taking Dan y Craig House, nearly parallel and on the right of Brecon and Abergavenny Canal, passing between it and the River Usk, in Llangattock and Llanelly parishes, 3 chains to the left of Llangattock Church, and 4 chains to the right of the Rectory, passing between Glan Usk-park and the Brecon and Abergavenny Canal; thence to Fro-farm-buildings, 2



chains to right of Llangynider Village, close to Pentwyn-buildings, 3 chains to the left of the Poor House in Llanthetty parish; twice crossing the Brecon and Abergavenny Canal, near Tanordig, close on the right of Llanthetty Rectory, and again crossing the canal near Ashford,  $6\frac{1}{2}$  chains to the right of Maesmawe House; thence crossing the River Asken, by the Mill in Llanvigan parish, 18 chains to right of Ty mawr; thence to Abercundrig, 11 chains to the right of Dinas; thence crossing the River Usk and the Brecon race-course, 4 chains to the right of Llanvaes toll-bar; thence by a tunnel under the high ground, in the parish of St. John the Evangelist, curving through Battle parish; thence to Abar bran vach, 3 chains to the right of Aber sefin, 2 chains to the left of Gilynos, crossing the River Usk, in Trallwng parish,  $1\frac{1}{2}$  chains to the left of Cwmysk, 2 chains to the right of Caer Hall; thence again crossing the River Usk, 14 chains to the right of Senny; thence slightly curving and re-curving to right of Trecastle, by means of an archway or tunnel on the east side thereof, 7 chains to the left of Llywell, 5 chains to the left of Maes-gwn; thence on the right and nearly parallel with the River Gwd de rig, crossing the same river, and passing through Frayan-mawr, to the left of Pentre Bach; thence curving through Llan fairary Bryn parish, and re-curving by means of a tunnel under the high ground in Llandincut parish, to the present intended termination at Llandovery.

#### CURVES.

The curves under three-quarters of a mile' radius, are one at Gloucester and one near Kilcot Inn, each of 55 chains' radius.



## GRADIENTS, &amp;c.

Datum—27 feet above the Ground of the Cattle Market, Gloucester.

| Distance from Gloucester Terminus. |                  | Length of each Plane |                  | Gradient. | Inclination. | Ascending or Descending. | Locations.                       |
|------------------------------------|------------------|----------------------|------------------|-----------|--------------|--------------------------|----------------------------------|
| Miles.                             | Chains.          | Ms.                  | Chs.             | Feet.     |              |                          |                                  |
| 2                                  | 2                | 2                    | 2                | 12.36     | 1 in 427     | Ascending                |                                  |
| 4                                  | 40               | 2                    | 38               | 2.02      | 1 in 2613    | Descending               |                                  |
| 13                                 | 18 $\frac{3}{4}$ | 8                    | 58 $\frac{3}{4}$ | 17.42     | 1 in 303     | Ascending                |                                  |
| 16                                 | 66 $\frac{3}{4}$ | 3                    | 48               | 27.35     | 1 in 193     | Descending               |                                  |
| 22                                 | 46 $\frac{1}{2}$ | 5                    | 59 $\frac{3}{4}$ |           |              | Level                    | Road to Lewstone.                |
| 25                                 | 52 $\frac{3}{4}$ | 3                    | 6 $\frac{1}{4}$  | 1 2.02    | 1 in 439     | Descending               | Old Turnpike-road to Hereford.   |
| 31                                 | 73               | 6                    | 20 $\frac{1}{4}$ | 20.       | 1 in 264     | Ascending                |                                  |
| 37                                 | 53 $\frac{3}{4}$ | 5                    | 60 $\frac{3}{4}$ | 12.51     | 1 in 422     | Descending               |                                  |
| 39                                 | 51 $\frac{3}{4}$ | 1                    | 78               | 9.11      | 1 in 579     | Ascending                |                                  |
| 50                                 | 3 $\frac{1}{2}$  | 10                   | 31 $\frac{3}{4}$ | 22.37     | 1 in 236     | Ascending                | Brecon and Abergavenny Canal.    |
| 53                                 | 9 $\frac{3}{4}$  | 3                    | 6 $\frac{1}{4}$  | 16.19     | 1 in 326     | Ascending                |                                  |
| 59                                 | 41 $\frac{1}{4}$ | 6                    | 31 $\frac{1}{2}$ |           |              | Level                    |                                  |
| 63                                 | 78               | 4                    | 36 $\frac{3}{4}$ | 8.88      | 1 in 594     | Ascending                | Turnpike-rd. to Llanfaes Summit. |
| 72                                 | 73 $\frac{1}{2}$ | 8                    | 75 $\frac{1}{2}$ | 28.54     | 1 in 185     | Ascending                |                                  |
| 74                                 | 13               | 1                    | 19 $\frac{1}{2}$ | 20.15     | 1 in 262     | Descending               |                                  |
| 76                                 | 63 $\frac{1}{4}$ | 2                    | 50 $\frac{1}{4}$ | 105.60    | 1 in 50      | Descending               |                                  |
| 80                                 | 18               | 3                    | 34 $\frac{3}{4}$ | 53.33     | 1 in 99      | Descending               | Llandovery.                      |

## TUNNELS.

| Nos.      | Length. | Height. | Below Surface. | Inclinations. | Locations.                                    |
|-----------|---------|---------|----------------|---------------|-----------------------------------------------|
|           | Yards.  | Feet.   | Feet.          |               |                                               |
| 1 . . . . | 50      | 30      | 123            | 1 in 290 ..   | Near Road to Linton.                          |
| 2 . . . . | 915     | 23      | 120            | 1 in 270 ..   | Turnpike-rd. from Hereford to Broms Ash.      |
| 3 . . . . | 660     | 32      | 186            | Level ..      | Road from Pencray to Glewstone.               |
| 4 . . . . | 1210    | 23      | 198            | 1 in 440 ..   | Turnpike-road to Ross.                        |
| 5 . . . . | 350     | 23      | 151            | 1 in 240 ..   | Near Turnpike-road from Monmouth to Winastow  |
| 6 . . . . | 320     | 25      | 120            | Level ..      | Near Turnpike-road from Brecon to Crickhowel. |

## PRINCIPAL EARTHWORKS.

| Description. | Length.  | Greatest height or depth. | Average height or depth. | Locations.                     |
|--------------|----------|---------------------------|--------------------------|--------------------------------|
|              | Ms. Chs. | Feet.                     | Feet.                    |                                |
| Embankment 1 | 69       | 33                        | 23                       | At Gloucester.                 |
| Embankment 3 | 60       | 36                        | 28                       | Gloucester and Hereford Canal. |



| Description. | Length. |      | Greatest height<br>or depth. |     | Average height<br>or depth. |     | Locations.                                                      |
|--------------|---------|------|------------------------------|-----|-----------------------------|-----|-----------------------------------------------------------------|
|              | Ms.     | Chs. | Feet.                        |     | Feet.                       |     |                                                                 |
| Cutting..... | 1       | 20   | ....                         | 97  | ....                        | 35  | Road to Linton.                                                 |
| Embankment   | 1       | 10   | ....                         | 50  | .....                       | 40  | Turnpike Road from Mars-<br>low to Goodrich.                    |
| Cutting..... |         | 44   | ....                         | 125 | .....                       | 100 | Near Road from Pencing to<br>Gloucester, west-end of<br>Tunnel. |
| Cutting..... | 1       | 40   | ....                         | 67  | .....                       | 33  | Road from Pen y Clawd.                                          |
| Embankment   | 1       | 60   | ....                         | 60  | .....                       | 30  | Turnpike Road from Chep-<br>stow to Ragland.                    |
| Cutting..... | 1       | 30   | ....                         | 50  | .....                       | 27  | Turnpike Road from Clytha<br>Hole.                              |
| Embankment   | 2       | 73   | ....                         | 62  | .....                       | 30  | Llangattock Village.                                            |
| Cutting..... |         | 62   | ....                         | 107 | .....                       | 70  | Lane from Poor House,<br>near 53 miles.                         |
| Embankment   | 3       | 40   | ....                         | 63  | .....                       | 40  | Old course of River Usk.                                        |
| Cutting..... | 1       | 6    | ....                         | 72  | .....                       | 45  | Turnpike Road from Brecon<br>to Crickhowell.                    |
| Embankment   | 3       | 8    | ....                         | 46  | .....                       | 38  | River Usk.                                                      |
| Cutting..... | 0       | 76   | ....                         | 96  | .....                       | 62  | West-end of Tunnel at 62 $\frac{3}{4}$<br>miles.                |
| Cutting..... | 1       | 60   | ....                         | 40  | ....                        | 30  | At 66 miles.                                                    |
| Cutting..... | 1       | 20   | ....                         | 93  | .....                       | 37  | Trecastle, west-end of<br>Tunnel.                               |
| Embankment   |         | 34   | ....                         | 85  | .....                       | 68  | River Gwddeng.                                                  |
| Cutting..... |         | 37   | ....                         | 108 | .....                       | 72  | Adjoining above.                                                |
| Embankment   |         | 65   | ....                         | 40  | ....                        | 31  | Llandovery.                                                     |

## CROSSINGS OF ROADS, &amp;c.

The highways, streets, and public roads, to be crossed by this railway, are ninety-six in number, fifty-two to be passed over and forty-four under; forty-four turnpike roads, nineteen over and twenty-five under; sixteen occupation roads, ten over and six under; one tram-way over, and one railway under; and thirty-six streams, brooks, &c.

The River Severn to be thrice crossed over by the railway, at elevations varying from 18 to 30 feet above the water's surface; the River Wye to pass 40 feet under, and the old course of the same river 60 feet; the Usk to pass six times under, besides eight other river crossings.



The canals to be passed over by the railway, are the Gloucester and Hereford, at 13 feet, and the Brecon and Aber-gavenny, at five several places, and 10 feet above the level of the water at each crossing respectively.

## REMARKS.

The whole length of this line is 80 miles and 18 chains, divided into seventeen planes, of which two are level, and amount together in length to 12 miles  $11\frac{1}{4}$  chains, and the rest inclining at the rate of from 1 in 50, or 105·60 feet per mile, to 1 in 2613, or 2·02 feet in a mile.

The plane of 1 in 50, which is 2 miles  $50\frac{1}{4}$  chains in length, and within  $3\frac{1}{2}$  miles of Llandovery, will require a stationary engine ; and the plane descending to that place, at the rate of 1 in 99, or 53·33 per mile, for 3 miles  $34\frac{3}{4}$  chains, will require an assistant engine ; the other most objectionable locomotive planes are, one which rises to the summit, at the rate of 28·54 feet per mile, or 1 in 185 ; and, lastly, one of 3 miles 48 chains in length, and about  $13\frac{1}{4}$  miles from Gloucester, falling at the rate of 27·35 feet per mile, or 1 in 193 ; the other gradients range from 20 feet to 2·02 feet in a mile. The summit is 7 miles  $24\frac{1}{4}$  chains from Llandovery, and 658 feet above the cattle market at Gloucester, the distance from which is 72 miles  $73\frac{1}{2}$  chains. There are two curves under  $\frac{3}{4}$  of a mile' radius.

The tunnels proposed, amount in length to 2 miles, save 15 chains. The Old River Usk embankment is  $3\frac{1}{2}$  miles in length, and averaging 40 feet high ; and the second Usk embankment, 3 miles and 8 chains in length, and averaging 38 feet in height.

The cutting at road from Pen y Clawdd,  $1\frac{1}{2}$  miles long and 33 feet deep ; that of 62 chains in length and averaging 70 feet in depth, near 53 miles from Gloucester ; and one of  $1\frac{3}{4}$  miles in length, and averaging 30 feet in depth, at 62 miles from Gloucester, are most worthy of notice.



The number of bridges required for roads, &c., is one hundred and seventy-seven ; and of bridges and culverts for brooks, &c., thirty-six.

The present line stops at Llandovery, but is proposed to be extended to Fishguard, otherwise Abergwain, in the county of Pembroke.

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### GLASTONBURY AND BRUTON RAILWAY.

This line commences at the wharf ground of the Glastonbury Canal Company, near St. Benedict's-bridge, Glastonbury, and proceeds through the parishes of Glastonbury, West Pennard, West Bradley, Balstonbury, East Pennard, Ditchheat, Lamy-at-Wyke, Champflower, and Pitchcomb, and terminates at the west end of the town of Bruton.

There is a branch proposed to Wincanton, which passes through the parishes of Bruton, Kedlynch, Shepton Montague, and Charlton Musgrove, and terminates at the intended station at Wincanton.

There are several quick curves in the line.

The earthworks are by no means heavy ; the principal is a cutting,  $1\frac{1}{4}$  miles long, and averaging 16 feet in depth.

#### CROSSINGS OF ROADS, &c.

The crossings consist of seven turnpike roads, five to be passed over and two under the railway, and one to be diverted ; five highways and parish roads, two to be passed over and three under ; and two occupation roads, two streams, and thirteen level crossings.



## GRADIENTS, &amp;c.

Datum—Level of Wharf Ground at Glastonbury.

| Distance from Glastonbury. |         | Length of each plane. |      | Gradient. | Inclination. | Ascending or Descending. | Location. |
|----------------------------|---------|-----------------------|------|-----------|--------------|--------------------------|-----------|
| Miles.                     | Chains. | Ms.                   | Chs. | Feet.     |              |                          |           |
| 3                          | 74      | 3                     | 74   | 5·35      | 1 in 986     | Ascending                |           |
| 5                          | 23½     | 1                     | 29½  | 10·60     | 1 in 498     | Ascending                |           |
| 5                          | 54½     |                       | 31   | 195·55    | 1 in 27      | Ascending                |           |
| 7                          | 0       | 1                     | 25½  | 11·       | 1 in 480     | Ascending                |           |
| 8                          | 36½     | 1                     | 36½  |           |              | Level                    |           |
| 12                         | 41      | 4                     | 4½   | 10·       | 1 in 528     | Ascending                |           |
| 13                         | 42½     | 1                     | 1½   | 17·71     | 1 in 298     | Ascending                | Bruton.   |

The branch to Wincanton is 4 miles  $26\frac{1}{2}$  chains in length, and rises at the rate of 1 in 215, or 24·55 feet in a mile.

## REMARKS.

The whole length of this line is 13 miles  $42\frac{1}{2}$  chains, and is divided into one level and six inclined planes, the former being 1 mile  $36\frac{1}{2}$  chains in length, and the latter varying in inclination from 1 in 27, or 195·55 feet per mile, to 1 in 986, or 5·35 feet per mile.

The worst plane is about  $5\frac{1}{4}$  miles from Glastonbury, and rising at the rate of 1 in 27, will require a stationary engine.

The Stockport locomotive plane ascends to Bruton at the rate of 1 in 298, and is not objectionable.

The Wincanton branch rises at the rate of 24·55 per mile.

The united lengths of the main line and branch amount to 17 miles 49 chains.

Fifteen bridges will be required for roads, &c., and two culverts for streams, and there are 13 level crossings.

The whole height allowed for turnpike roads passing under the railway is 14 feet 9 inches, which, after deducting 3 feet for the arch, ballasting, and rails, leaves only 11 feet 9 inches for clear headway.



## GLOUCESTER AND BRISTOL RAILWAY.

JAMES WALKER, F.R.SS. L. and E., and A. BURGESS, ESQRS., Engineers.

The main line commences  $1\frac{1}{2}$  chains from Narrow Wine-street, Bristol, crosses the river diagonally, thence cutting the same river again by the bridge at Hollen-street, passes through the parish of St. Philip and Jacob, and 3 chains to the left of the Armoury; thence crossing the turnpike-road, by Lebeck-gate, and passing  $6\frac{1}{4}$  chains to the right of Blackbird's-gate,  $13\frac{1}{2}$  chains from which the branch to the Great Western Railway diverges, crossing Lawrence-hill, and running parallel with the Coal Pit-heath Railway, terminates at the station of the Great Western Railway, by Bristol-harbour. The main line, from the point where the branch to the Great Western station diverges, continues 12 chains to the right of Black Swan Inn, 5 chains to the left of the French Prison, 13 chains to the left of Hambrook, 13 chains to the right of Mulgrave Farm, 5 chains to the left of Winterbourne Church, 5 chains to the right of Perrin-pit Farm,  $1\frac{1}{2}$  chains to the left of the Folly,  $9\frac{1}{2}$  chains to the left of Laden Bowsbridge; thence thrice crossing the River Laden, and passing between Ashory Farm and Stidcot, 8 chains to the right of Tapwell-bridge, 9 chains to the left of Crimhall Church, and 8 chains to the right of Manor House; 7 chains to the left of Sodom Mill, 3 chains to the left of Everleigh lime-kilns,  $4\frac{1}{2}$  chains to the right of Falfield Mill, 1 chain to the left of Henage Court Farm,  $4\frac{1}{2}$  chains to the left of Skay's Grove, passing between Middle Mill, and Middle Mill Farm, across Woodford-green, close on the right of Swanley-green, 6 chains to the left of Hogsdown Farm, crossing the turnpike-road to Berkeley at Atchington; thence to the left of Clingre House, 5 chains to the left of Fore-bridge, 12 chains to the left of Field's-lane Farm, 6 chains to



the left of Draycot Mill, on the road from Dursley to Cambridge, 11 chains to the left of Coaley village, 4 chains to the left of Frocester village, 6 chains to the left of the clothing mill in Leonard Stanley parish; thence crossing the Stroud-water Canal, on the east side of which the Stroud branch leaves the main line, and runs with a curve of 36 chains' radius, through Stone-house, meeting the Cheltenham and Great Western Union Railway near Stonehouse Cottage, the main line thence continuing 7 chains to the right of Old End, and joining the Cheltenham and Great Western Union Railway, in Morton Valence parish.

## CURVES.

The objectionable curves are, one of 15 chains' radius in the branch to the Great Western Railway, and one of 36 chains' radius in the Stroud branch.

## GRADIENTS, &amp;c.

Datum—Surface of Floating Harbour, Bristol.

| Distance from Gloucester. |         | Length of each plane. |      | Gradient. | Inclination. | Ascending or Descending. | Location.                                   |
|---------------------------|---------|-----------------------|------|-----------|--------------|--------------------------|---------------------------------------------|
| Miles.                    | Chains. | Ms.                   | Chs. | Feet.     |              |                          |                                             |
| 0                         | 20      | 0                     | 20   |           |              | Level                    |                                             |
| 6                         | 10      | 5                     | 70   | 17.60     | 1 in 300     | Ascending                |                                             |
| 11                        | 0       | 4                     | 70   | 2.        | 1 in 2640    | Ascending                |                                             |
| 12                        | 0       | 1                     | 0    | 7.83      | 1 in 674     | Descending               | Cromhall-common.                            |
| 16                        | 10      | 4                     | 10   | 17.60     | 1 in 300     | Descending               | Near Woodford-green                         |
| 20                        | 0       | 3                     | 70   | 8.        | 1 in 660     | Ascending                |                                             |
| 20                        | 60      | 0                     | 60   |           |              | Level                    |                                             |
| 23                        | 0       | 2                     | 20   | 5.        | 1 in 1056    | Descending               |                                             |
| 23                        | 74.5    | 0                     | 74.5 |           |              | Level                    |                                             |
| 26                        | 21.33   | 2                     | 26.8 | 17.54     | 1 in 301     | Ascending                | Cheltenham and Great Western Union Railway. |

The branch to the Great Western Railway is 1 mile  $21\frac{3}{4}$  chains in length, and consists of two planes, the former descending, at the rate of 1 in 200, to Avon-street, and the latter level, for 5 chains, to the Great Western Railway.



The Stroud branch is 1 mile  $51\frac{3}{4}$  chains in length, and rises to the Cheltenham and Great Western Union Railway, at the rate of 1 in 205.

The intended tunnel at Cromhall is 489 yards long, 25 feet high, and 118 feet below the summit of hill.

#### PRINCIPAL EARTHWORKS.

##### MAIN LINE.

| Description. | Length. |                 | Greatest height<br>or depth. | Average height<br>or depth. | Locations.                                        |
|--------------|---------|-----------------|------------------------------|-----------------------------|---------------------------------------------------|
|              | Ms.     | Chs.            | Feet.                        | Feet.                       |                                                   |
| Cutting .... | 0       | $41\frac{1}{2}$ | 68                           | 50                          | Stapleton Parish.                                 |
| Cutting .... | 1       | 33              | 40                           | 22                          | Stapleton and Winterbourn.                        |
| Cutting .... | 0       | 22              | 70                           | 50                          | Cromhall.                                         |
| Embankment   | 2       | 46              | 55                           | 33                          | Cromhall and Thornbury.                           |
| Embankment   | 1       | 64              | 63                           | 38                          | Leonard Stanley, Stone<br>House & Moreton Valence |

##### BRANCH TO THE GREAT WESTERN RAILWAY.

|            |   |    |    |    |                             |
|------------|---|----|----|----|-----------------------------|
| Embankment | 0 | 50 | 38 | 26 | At junction with main line. |
|------------|---|----|----|----|-----------------------------|

##### STROUD BRANCH.

|              |   |    |    |    |                                                      |
|--------------|---|----|----|----|------------------------------------------------------|
| Embankment   | 0 | 72 | 40 | 26 |                                                      |
| Cutting .... | 0 | 42 | 35 | 23 | Junction with Cheltenham<br>& Great Western Railway. |

##### CROSSINGS OF ROADS, &c.

According to the Parliamentary Section there are fourteen turnpike-roads proposed to be crossed by this railway, five to be passed over, and nine under; fifty-four streets, highways, and parish-roads, nineteen over, and thirty-five under, including the streets at Bristol, to be crossed by the two proposed viaducts; thirty-five occupation-roads, eleven over, and twenty-four under; fifty-one footpaths, twenty-four streams, brooks, &c., and one coal railway. The River Frome is to be passed four, and the River Laden six times under the railway. The Stroudwater Canal is to be passed under the railway at 40 feet below the rails' surface.



## REMARKS.

The whole length of this line and branches is 29 miles 14·83 chains. The main line consists of three level planes, amounting in length to 1 mile  $74\frac{1}{2}$  chains, and seven inclined planes, having gradients varying from 2 feet to 17·60 feet per mile.

The branch to the Great Western Railway, falls at the rate of 1 in 200, and the Stroud branch rises to the Cheltenham and Great Western Union Railway, at the rate of 1 in 205.

The heaviest embankment is that of Cromhall, which is 2 miles and 56 chains in length, and averages about 30 feet in height.

The chief cutting is in Stapleton and Winterbourn, 1 mile and 33 chains in length, and averaging 22 feet in depth. There is one short tunnel at Cromhall.

The bridges required to pass roads, streets, &c., over and under the railway, are one hundred and sixty-six in number, which includes the arches of the two Bristol viaducts; and the culverts and bridges for brooks, streams, &c., twenty-four in number.

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GRAND CONNECTION RAILWAY.

GEORGE LANDMANN, ESQ., Engineer.

This line joins the Birmingham and Gloucester Railway, in the hamlet of Wadborough, in the parish of St. Andrew, Pershore, in the county of Worcester, and proceeds 4 chains to the right of Norton, 6 chains to the right of Newland Farm, 5 chains to the left of Upper Battenhall, 7 chains to the left of Middle Battenhall, crosses the London-road,  $10\frac{1}{2}$  chains to the right of Lower Battenhall, and 7 chains to the right of Union Farm; thence crossing the road from Virgin's Tavern to



Worcester, a quarter of a mile from the bridge over the Birmingham Canal, 3 chains to the right of Rainbow Villa, 8 chains to the right of Astwood, across the Worcester and Birmingham Canal,  $1\frac{1}{2}$  chains to the left of Spellis; thence to Fernall Heath, curving 16 chains to the right of Harford Hill, and passing 6 chains to the right of May House; thence through buildings in Doverdale parish,  $6\frac{1}{2}$  chains to the right of Doverdale Church, 3 chains to the right of Upper Moor, 21 chains to the right of the Talbot Inn in Sandy-lane, 4 chains to the right of Goldner's House; thence close to Torton, taking Hoo Brook Mill in the line, 24 chains to the left of Spennel's Mill Pool; thence curving to within 19 chains of Hill Grove, which is on the right, 25 chains to the right of the Town of Kidderminster, within 24 chains of Oaklands on the left, 23 chains to the right of Bennison's Pool, near which it enters the county of Stafford; thence 19 chains to the right of New Barn, 5 chains to the left of New Wood; thence crossing the Stourbridge Canal and the River Stour, 7 chains to the left of Friars Gorse, 14 chains to the left of Ashwood, or Ridge Hill Plantation, 3 chains to the right of Ashwood Field House; thence crossing the road from Town's End, and the road to Wall Heath, crossing Short End Railway, nearly at right angles, 13 chains to the left of the Windmill, near Wall Heath Forge, 15 chains to the right of Hinksford, 13 chains to the right of Swindon; thence curving to within  $9\frac{1}{2}$  chains of Botteram Gorse, 4 chains to the left of Blankeley, 18 chains to the right of the Bratch, 2 chains to the left of Field Barn, 2 chains to the left of Oretton; thence curving 7 chains to the left of Langley Hall, 13 chains to the left of Finchfield, 3 chains to the left of Horse Hill Farm, 6 chains to the right of Chapel Ash; thence skirting the Wolverhampton Race Course, and crossing Whitmore End-lane, Dunstall-lane, and several roads at Wolverhampton, and also the Birmingham Canal, joins the line of the Grand Junction



Railway by two branches, the right branch proceeding near to Causy Lake, and the left branch to near the road to Skew Hole.

The line to Stourbridge leaves the main line by two branches near New Wood, in the parish of Kinfare and terminates in a plot of ground 10 chains to the right of the Stourbridge Iron Works.

## CURVES.

The most objectionable curves are by Wolverhampton Race Course, one of 33, and one of 40 chains' radius; a third is of 52 chains' radius in the right branch to the Grand Junction Railway; and, lastly, there is one of half a mile' radius in the left branch to the same line.

## GRADIENTS, &amp;c.

| Distance from Pershore. |         | Length of each plane. |      | Gra-dients. | Inclina-tions. | Ascending or Descending. | Locations.                            |
|-------------------------|---------|-----------------------|------|-------------|----------------|--------------------------|---------------------------------------|
| Miles.                  | Chains. | Ms.                   | Chs. | Feet.       |                |                          |                                       |
| 0                       | 31      | 0                     | 31   |             |                | Level.                   |                                       |
| 3                       | 32½     | 3                     | 1½   | 4·41        | 1 in 1195      | Ascending.               |                                       |
| 8                       | 67¾     | 5                     | 35¼  | 4·03        | 1 in 1307      | Descending.              | Near R. Salwarp.                      |
| 9                       | 51¼     | 1                     | 63½  |             |                | Level                    | Near Turnpike-road to Droitwich.      |
| 16                      | 72½     | 7                     | 21¼  | 10·05       | 1 in 525       | Ascending.               | Near Hoo Brook.                       |
| 22                      | 23¾     | 5                     | 31¼  | 16·         | 1 in 330       | Ascending                |                                       |
| 26                      | 40¾     | 4                     | 16½  |             |                | Level                    |                                       |
| 29                      | 40¾     | 3                     | 0½   | 16·         | 1 in 330       | Ascending                |                                       |
| 30                      | 12½     | 0                     | 51¾  |             |                | Level                    |                                       |
| 31                      | 12½     | 1                     | 0    | 63·61       | 1 in 83        | Ascending                |                                       |
| 33                      | 64      | 1                     | 51½  | 20·70       | 1 in 255       | Ascending                |                                       |
| 35                      | 1       | 1                     | 17   | 17·95       | 1 in 294       | Ascending                | Summit.                               |
| 35                      | 56¾     | 0                     | 55¾  |             |                | Level                    | Junction with Grand Junction Railway. |

The branch from the main line to the Grand Junction Railway leaves the former at 35 miles 1 chain from Pershore, and is 59¼ chains in length, rising at the rate of 1 in 369.

The Stourbridge junction line diverges from the main line by two branches, which uniting together, proceed to the intended



station near the Stourbridge Iron Works: the total length of these branches is 1 mile and 53 chains, and the whole is level.

The proposed Wolverhampton Tunnel is 132 yards in length, 15 feet high, and 132 feet below summit of ground, inclining at the rate of 17·50 feet per mile. The tunnel in Stourbridge Branch is 440 yards long, 25 feet high, and 136 feet below summit of Hill.

#### PRINCIPAL EARTHWORKS.

| Description.    | Length. |      | Greatest height or depth. |  | Average height or depth. |  | Locations.                                             |
|-----------------|---------|------|---------------------------|--|--------------------------|--|--------------------------------------------------------|
|                 | Ms.     | Chs. | Feet.                     |  | Feet.                    |  |                                                        |
| Cutting . . . . | 1       | 36   | 54                        |  | 22                       |  | Junction with the Birmingham and Gloucester Railway.   |
| Cutting . . . . |         | 34   | 60                        |  | 32                       |  | Between 4 and 5 miles.                                 |
| Embankment      | 1       | 15   | 37                        |  | 20                       |  | Birmingham and Worcester Canal, between 5 and 7 miles. |
| Cutting . . . . | 1       | 40   | 38                        |  | 24                       |  | Between 12 and 15 miles.                               |
| Embankment      |         | 55   | 68                        |  | 26                       |  | Hoo Brook.                                             |
| Cutting . . . . | 1       | 40   | 29                        |  | 18                       |  | Between 17 and 19 miles.                               |
| Embankment      |         | 58   | 60                        |  | 20                       |  | Near turnpike-road, from Kidderminster to Stourbridge. |
| Cutting . . . . |         | 55   | 78                        |  | 28                       |  | Contiguous to above.                                   |
| Cutting . . . . |         | 67   | 65                        |  | 36                       |  | Between 21 and 23 miles.                               |
| Embankment      |         | 34   | 67                        |  | 32                       |  | River Stour.                                           |
| Cutting . . . . | 1       | 45   | 75                        |  | 36                       |  | Contiguous to above.                                   |
| Cutting . . . . |         | 53   | 68                        |  | 34                       |  | By entrance to Wolverhampton tunnel.                   |

In the Stourbridge Junction line there are three cuttings; one of 34 chains in length, and averaging 40 feet in depth; a second of 40 chains in length, and averaging 32 feet in depth; and, lastly, one of 29 chains in length, and averaging 38 feet in depth.

#### CROSSINGS OF ROADS, &c.

The turnpike-roads proposed to be crossed by this railway are



fourteen in number, nine to be passed over and five under; forty-six high-ways and parish roads, twenty-seven over and nineteen under; thirty-two occupation roads, twenty over and twelve under; thirty-nine foot-paths; twenty-six brooks, streams, &c., and twenty-eight level crossings. The Short End Railway is proposed to be crossed in the level of the rails; the Rivers Salwarp and Stour to be passed under the railway, the former at 46, and the latter at 71 feet below the rails' surface.

The canals to be crossed are the Birmingham and Worcester, which is 32 feet, the Droitwich, which is 25, and the Stour-bridge, which is 37 feet below the rails' top surface.

## REMARKS.

The whole length of this line is 35 miles and  $56\frac{3}{4}$  chains, and consists of five level and eight inclined planes, of which the former amount to 7 miles  $58\frac{1}{2}$  chains.

The gradients of the inclined planes range from 63·61 feet per mile, or 1 in 83, to 4·03 feet per mile. or 1 in 1307.

The steepest inclination is for a mile in length, is nearly the same as that of the Sutton plane on the Manchester and Liverpool Railway, and will require an assistant engine; the next plane, of greater inclination than 1 in 330, or 16 feet per mile, rises at the rate of 20·70 feet per mile, or 1 in 255, for 1 mile  $51\frac{1}{2}$  chains. The summit is  $55\frac{1}{4}$  chains from the Grand Junction Railway at point of junction, and 229 feet 2 inches above the Birmingham and Gloucester Railway in Wadborough Township.

There are four curves of less radius than  $\frac{3}{4}$  of a mile.

The tunnelling amounts in length to 572 yards.

The heaviest embankment is between five and seven miles from the Pershore Terminus, is 1 mile 15 chains in length, and averages 20 feet in height; the principal cutting is near the River Stour, and is 1 mile 45 chains in length, and averages 36 feet in depth.



The bridges required for crossing roads, &c, are one hundred and thirty-six, and the culverts and bridges for brooks, streams, &c., twenty-six in number.

The clear height for turnpike-road arches, under the railway, is 16 feet, and for arches of roads over the railway, 14 feet.

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## GREAT NORTH OF ENGLAND RAILWAY.

### PROPOSED EXTENSION TO THE YORK AND NORTH MIDLAND RAILWAY.

THOMAS STORY, Esq., Engineer.

This extension commences in the parish of Hurworth-upon-Tees, at the township road from Croft-bridge to Hurworth, and crosses the River Tees, 35 chains from the bridge; thence passing to near Pepper-field House, within 5 chains of Cooper House, which is on the east, and Cowton Moor House, which is 8 chains to the west, continues in a straight line to within 13 chains of Birkby, on the east, and slightly curving, passes 10 chains to the east of Hutton Bonville Hall; thence pursues a direct course to the west of the game-keeper's house in the Township of North Otterington; thence to the west of the Manor-house and pasture field, in the parish of Kirby Wiske, slightly curving to near Woodhill-field, on the east, and Carlton Cottage, within 10 chains, on the west, beyond which the Thirsk branch, which is 1 mile and 10 chains in length, diverges; the main line continues to Sowerby-park, past Coates's Farm, across Pill Moor, by Lee's Barn, which is on the east, and Spring House, just beyond, on the west; thence



to within 5 chains of Newton Grange, on the east, within 10 chains of Nether Poppleton Church, on the west; thence to the York and North Midland Railway, near Micklegate Bar, in the City of York, by a branch of 78 chains in length; the main line bearing to the west, and forming a second junction with the same railway, at a little less than a mile from York.

The branch to the City of Durham leaves the main line about 15 chains south of Pelaw Wood House, and terminates in a plot of ground abutting south on Gilesgate.

The Thirsk branch presents a curve of a quarter of a mile radius.

## GRADIENTS, &amp;c.

Datum—6·21 feet below West end of Askew's Quay.

| Distance from Hurworth. |         | Length of each plane. |      | Gra-dient. | Inclina-tion. | Ascending or Descending. | Locations.                                                    |
|-------------------------|---------|-----------------------|------|------------|---------------|--------------------------|---------------------------------------------------------------|
| Miles.                  | Chains. | Ms.                   | Chs. | Feet.      |               |                          |                                                               |
| 2                       | 58      | 2                     | 58   | 13·75      | 1 in 384      | Ascending                | Private Carriage Road to Hutton Bonville.                     |
| 6                       | 73      | 4                     | 15   | 8·80       | 1 in 600      | Descending               |                                                               |
| 11                      | 34      | 4                     | 41   | 4·16       | 1 in 1269     | Ascending                | To River Ouse.                                                |
| 17                      | 16      | 5                     | 62   | 8·40       | 1 in 628      | Descending               |                                                               |
| 19                      | 18·70   | 2                     | 2·70 |            |               | Level                    |                                                               |
| 23                      | 79·70   | 4                     | 61   | ·55        | 1 in 9453     | Descending               |                                                               |
| 29                      | 27·70   | 5                     | 28   | 6·42       | 1 in 822      | Descending               |                                                               |
| 38                      | 19·70   | 8                     | 72   | 1·56       | 1 in 3378     | Descending               | Junction with the York and North Midland Railway at Hob Moor. |
| 40                      | 33·70   | 2                     | 14   | 4·48       | 1 in 1178     | Descending               |                                                               |
| 41                      | 46·70   | 1                     | 13   | 6·80       | 1 in 776      | Ascending                |                                                               |

The Durham branch is 55 chains long, and rises to its termination, near Giles's Gate, at the rate of 1 in 100.

The Thirsk branch is 1 mile 10 chains long, and rises to its intended terminus, near that place, at the rate of 1 in 247.

The branch to York is 68 chains long, and rises to the York and North Midland Railway, near Micklegate Bar, at the rate of 1 in 523.

The Ouse embankment is the chief earthwork, and is nearly 3 miles long, and averages 12 feet high.



## CROSSINGS OF ROADS, &amp;c

The turnpike roads intended to be crossed by this railway are seven in number, four to be passed over and three under; twenty-six high roads and parish roads, ten over and sixteen under; twenty-one occupation roads, nine over and twelve under; three footpaths, twenty-seven brooks, streams, &c., and the New Cut, under. The River Tees to be passed over by the railway at an elevation of 49 feet, and the Ouse at 30 feet 1 inch above the water's surface, of each.

The River Wiske is also to be passed under.

## REMARKS.

The whole length of this extended line is 41 miles 46·70 chains, and has one level plane 2 miles 2·70 chains in length; and nine slightly inclined planes, with excellent gradients, the steepest rising from its junction, with the original line in Hurworth, at the rate of 13·75 feet per mile, or 1 in 384.

The Durham branch inclines at the rate of 1 in 100, but its length being only 55 chains, and the ascent being in the direction for arrival, it is of little import.

The gradient of the Thirsk branch is 21·36 feet per mile; this plane also ascends in the right direction. The only unfavourable curve, is in this branch, and is of a quarter of a mile' radius.

The earthworks are not worthy of particular mention.

The bridges required for rivers, roads, &c., are sixty-one; and the bridges and culverts for brooks, streams, &c., twenty-seven in number.

The clear height allowed for turnpike road arches, both above and below the railway, is 16 feet; this is a fit standard.

This line will form a link of the grand trunk from London to Edinburgh.

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## GREAT NORTH OF ENGLAND, CLARENCE, AND HARTLEPOOL JUNCTION RAILWAY.

S. ROBINSON, Esq., Engineer.

The main line commences on the Wingate branch of the Hartlepool Railway, in the parish of Castle Eden, and by a curvilinear course, intersects the southern part of the wood in the Township of Wingate, and recurving to the north-east and past the quarries in the township of Trindon, within 5 chains south-west of the one, and 3 chains south-west of the other, and passing within 5 chains and to the north of Bore-hole, and 11 chains south of Coxhoe Mill, 2 chains south of Cornforth Mill, 3 chains north of Cornforth, whence the branches diverge, continues to its junction with the Byers-green branch of the Clarence Railway.

The branches proceed, the one in a northerly, the other in a southerly direction, each to its junction with the intended Great North of England Railway.

### CURVES.

The curves, under three quarters of a mile' radius, are, one in the Township of Wingate, of half a mile, a second at Cornforth of 35 chains, and two in the branches to the Great North of England Railway; that in the north branch of a quarter of a mile, and that in the south branch, 30 chains' radius.

### GRADIENTS, &c.

The main line is 8 miles 33·95 chains in length, and consists of one level plane 2 miles 45·50 chains in length, and two inclined planes, the former leaving the Wingate branch, with a



rise of 1 in 159, or 33·20 feet per mile, and the latter falling towards the Byers-green branch of the Clarence Railway, at the rate of 125·70 feet per mile, or 1 in 42.

The gradients of the branches to the Great North of England Railway are 42·58 feet, 9·23 feet and 3·33 feet per mile: that of 42·58 or 1 in 124 is on the south branch for a length of 62 chains, and is the most objectionable.

The chief earthwork is an embankment, contiguous to the Byers-green branch of the Clarence railway,  $1\frac{1}{2}$  miles in length, and averaging about 20 feet in height.

#### CROSSINGS OF ROADS, &c., OF MAIN LINE.

The Durham and Stockton turnpike road is five feet above the surface of rails, and is to be raised 13 feet. There are three roads over the railway, five roads under, and one occupation road under.

The road to Trindon to be crossed on the level.

The Clarence Railway is 32 feet 5 inches under, and the south branch thereof, 23 feet under; and the Great North of England Railway, 36 feet under.

#### CROSSINGS OF ROADS, &c., OF SOUTH BRANCH.

The Great North of England Railway is 10 feet above rails' surface at point of crossing; and the Clarence Railway is crossed on the level of the rails. The road from Thinforth Mill to Cornforth is 10 feet above the rails, and is to be lowered and crossed on the surface.

#### REMARKS.

The whole length of the main line and branches is 9 miles 65·95 chains. The gradients are 33·20 feet, 125·70 feet,



42·58 feet, and 3·33 feet per mile; the worst of these is in the main line, falling at the rate of 1 in 42, for a length of 1 mile 48 chains.

There are four curves of less radius each than three quarters of a mile.

Thirteen bridges will be required for road bridges, &c.

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## GREAT WESTERN RAILWAY.

### PROPOSED DIVERSIONS.

J. K. BRUNEL, Esq., F.R.S., Engineer.

#### DIVERSION No. 1.

This diversion is in Bathwick parish, and extends for 4·15 chains, with a rise of 1 in 880, or 6 feet in a mile. The Kennet and Avon Canal is proposed to be diverted, for a length of 35 chains.

#### DIVERSION No. 2.

This diversion is in Bathampton and Bathford parishes, and crosses in its course the River Avon, and passing 7 chains to the right of Bathford,  $1\frac{1}{2}$  chains to the right of Treverne's Mill, and across Box Brook, extends for 2 miles and 26 chains, rising to its junction with the original line, at the rate of 5·80 feet in a mile. The road to Box is proposed to be diverted for 27 chains in length. There is an embankment in this diversion 1 mile 65 chains long, and about 25 feet high.

#### DIVERSION No. 3.

The third diversion is in the Bradford and Trowbridge Branch, in the parishes of Melksham and Broughton Clifford,



and commences at a point 16 chains to the right of Mill Farm ; thence passing 7 chains to the right of Frying Pan Farm, half a chain to the left of Dunkirk Mill, and 8 chains to the left of Melksham, continues to its junction with the original line in Melksham parish.

The length of this diversion is 3 miles 70 chains, and has two planes, the former 2 miles and 27 chains long, falling at the rate of 13·71 feet in a mile, and the latter 1 mile 43 chains, also falling to its junction with the main line, at the rate of 12·36 feet.

It is chiefly in embankment, averaging about 16 feet in height.

#### DIVERSION No. 4.

This diversion commences in Casham parish, and extending for 1 mile 41 chains in that, and the adjoining parish of Chippenham, falls to the original line, at the rate of 4·29 feet in a mile.

#### DIVERSION No. 5.

#### THE PROPOSED SWINDON DEVIATION.

This diversion commences near Studley Wood, and proceeds to the right of Upper Studley Farm, and 14 chains to the left of Blagrove Farm ; thence slightly curving to within 10 chains of Faringstall on the left,  $6\frac{1}{2}$  chains to the left of Even Swindon, crossing the North Wilts Canal, at the road to Rodburn, 3 chains to the left of South Brook ; thence passing to Stratton, 15 chains to the right of its church, 6 chains to the right of Burdock's Farm, and the same distance from Howe's Farm, 6 chains to the left of Tuggy's Farm, 17 chains to the right of Rodborough Farm, crossing the Wilts and Berks Canal  $1\frac{1}{2}$  chains to the left of Burton Wharf, from whence a diversion of the canal is proposed for 37 chains in length ; thence within 15 chains and to the left of Cowleaze Farm, opposite to which another diversion of the same canal is proposed, for a length of 45 chains ; thence within 16



chains of Becket park on the left,  $15\frac{1}{2}$  chains on the left of Galley Horns, opposite to which a third diversion of the same canal is proposed for a length of 63 chains; thence continuing to its junction with the main line at the road to Fernham.

#### GRADIENTS, &c., OF DIVERSION No. 5.

Datum—Level of Water of the Bristol Float.

| Distance from Junction with Main Line. |                 | Length of each plane. |                 | Gradient. | Inclination. | Ascending or Descending. | Locations.               |
|----------------------------------------|-----------------|-----------------------|-----------------|-----------|--------------|--------------------------|--------------------------|
| Miles                                  | Chains.         | Ms.                   | Chs.            | Feet.     |              |                          |                          |
| 1                                      | 48              | 1                     | 48              | 6·        | 1 in 880     |                          |                          |
| 3                                      | $48\frac{1}{2}$ | 2                     | $0\frac{1}{2}$  |           |              | Level                    |                          |
| 6                                      | 0               | 2                     | $31\frac{1}{2}$ | 5·01      | 1 in 1053    | Descending               |                          |
| 13                                     | 50              | 7                     | 50              | 6·87      | 1 in 768     | Descending               | Junction with Main Line. |

#### DIVERSION No. 6.

(From the River Lodden to the River Thames.)

This diversion leaves the main line at its intersection of the River Lodden, and passing through Sonning parish, crosses the River Kennet, 3 chains from its entrance into the Thames; thence continuing through the parishes of St. Mary and St. Lawrence, Reading, and skirting the Thames, passes through Purley-grounds,  $4\frac{1}{2}$  chains to the right of the house; thence to Pangbourn, and running nearly parallel with the Thames, approaches a second bend of that river, within  $2\frac{1}{2}$  chains, in Pangbourn parish; thence passing 6 chains on the right of Bassilden-park, and from  $5\frac{1}{2}$  to 8 chains to the right of Bassilden, joins the Parliamentary line at the crossing of the Thames.



## GRADIENTS, &amp;c. OF DIVERSION No. 6.

Datum—Fifty Feet above Water of Bristol Float.

| Distance from<br>Junction with<br>Main Line. |                  | Length of<br>each plane. |                  | Gra-<br>dient. | Inclina-<br>tion. | Ascending or<br>descending. | Locations.                  |
|----------------------------------------------|------------------|--------------------------|------------------|----------------|-------------------|-----------------------------|-----------------------------|
| Miles.                                       | Chains.          | Ms.                      | Chs.             | Feet.          |                   |                             |                             |
| 1                                            | 70               | 1                        | 70               | 3.73           | 1 in 1414         | Ascending                   |                             |
| 2                                            | 1 $\frac{3}{4}$  |                          | 11 $\frac{3}{4}$ |                |                   | Level                       |                             |
| 3                                            | 40 $\frac{3}{4}$ | 1                        | 39               | 4.03           | 1 in 1309         | Descending                  |                             |
| 6                                            | 8 $\frac{1}{2}$  | 2                        | 47 $\frac{3}{4}$ |                |                   | Level                       |                             |
| 8                                            | 0                | 1                        | 71 $\frac{1}{2}$ | 2.64           | 1 in 1999         | Ascending                   |                             |
| 9                                            | 69               | 1                        | 69               | 4.             | 1 in 1229         | Ascending                   |                             |
| 11                                           | 24               | 1                        | 35               | 1.04           | 1 in 5060         | Descending                  |                             |
| 12                                           | 35               | 1                        | 11               | 1.32           | 1 in 4000         | Ascending                   | Junction with Main<br>Line. |

## REMARKS.

The Swindon, and the Lodden and Thames diversions, are the principal; the former is for 13 miles 50 chains, and the latter for 12 miles 35 chains in length.

The gradients of all the diversions are unexceptionable.

Thirty-two bridges and culverts will be required for roads, streams, &c., in the Swindon branch, and the Kennet and Avon Canal is to be thrice diverted.

In the Lodden and Thames diversion, twenty-eight bridges and Culverts will be required, and the road from Woodley-green is proposed to be diverted.

## GREAT WESTERN RAILWAY.

## EXTENSION TO PADDINGTON.

J. K. BRUNEL, Esq., F.R.S., Engineer.

This line joins the Great Western Railway at Acton, near the road from Apperton to London; crosses Old Oak-common, passes within one chain of the Grand Junction Canal, by the



north-west corner of Wormwood Scrubs, west of Porto Bello, east of the Harrow-road, and continues to its termination in a parcel of ground on the south side of the canal basin at Paddington, and but little more than a mile from where Tyburn toll-house formerly stood. The whole length of this extension is 4 miles 44 chains, and falls to the intended Paddington station at the rate of four feet per mile.

#### CROSSINGS OF ROADS, &c.

The road to Acton is to be raised 18 feet, Black Lion-lane, 14 feet, and Westbourn-street, 18 feet; and severally carried over the railway by means of bridges.

There is one level crossing.

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## HAMPSHIRE AND WILTSHIRE JUNCTION RAILWAY.

EDWIN OCTAVIUS TREGELLES, Esq., Civil Engineer.

FRANCIS GILES, Esq., Consulting Engineer.

This line leaves the Southampton Railway by two curved branches, in East Leigh tything, and parish of North Stoneham, passes 11 chains to the right of the Hut; thence to within  $1\frac{1}{2}$  chains of Chandler's Ford on the right, 18 chains to the left of Ram-alley, 4 chains to the left of Badderley-common, 9 chains to the right of Poole's Barn, 3 chains to the left of Crampmoor; thence to Holterworth, and a quarter of a mile to the left of Hunter's Inn, 11 chains to the right of the Canal Bridge at Romsey, 28 chains to the left of Great Bridge, 22 chains to the left of Stanbridge Farm, 10 chains to the left of River Bridge Mill, 4 chains to the left of Dunbridge, 15 chains to the left of Dunbridge Farm, 16 chains to the left of Schoolhouse Farm, 5 chains to the left of Lockerley Church; thence



through Lockerley, 9 chains to the left of Roebury Mill, 24 chains to the right of East Dean Church, 7 chains to the right of Jerrett's Farm, 5 chains to the right of West Dean Church; thence through Fine Wood, Churchway Wood, and High Wood, and passing through East Grimstead, 16 chains to the right of the Chapel, 6 chains to the left of Butter Furlong Farm,  $1\frac{1}{2}$  chains to the right of the Dog Kennel, in West Grimstead parish; thence through Alderbury parish, and 5 chains to the left of the Brick Kiln in Clarendon parish, 10 chains to the left of Ashley Hill Farm, 2 chains to the right of Peter's Finger turnpike-gate, 12 chains to the left of Milford Farm; thence continuing to its termination in a plot of ground about 15 chains to the east of Salisbury Town.

## CURVES.

The curves under three-quarters of a mile' radius, are one of 25, and a second of 22 chains', leaving the Southampton Railway.

## GRADIENTS, &amp;c.

Datum—Level of the London and Southampton Railway at point of Junction.

| Distance from Junction with Southampton Railway. |                 | Length of each Plane |                 | Gradient. | Inclination. | Ascending or Descending. | Locations.          |
|--------------------------------------------------|-----------------|----------------------|-----------------|-----------|--------------|--------------------------|---------------------|
| Miles.                                           | Chains.         | Ms.                  | Chs.            | Feet.     | Feet.        |                          |                     |
| 4                                                | 10              | 4                    | 10              | 16·97     | 1 in 311     | Ascending.               |                     |
| 4                                                | $53\frac{1}{4}$ | 0                    | $43\frac{1}{4}$ |           |              | Level.                   |                     |
| 6                                                | 32              | 1                    | $58\frac{3}{4}$ | 23·15     | 1 in 228     | Descending               |                     |
| 18                                               | 20              | 1                    | 68              |           |              | Level.                   |                     |
| 1                                                | 53              | 3                    | 33              | 11·73     | 1 in 450     | Ascending.               |                     |
| 14                                               | 50              | 2                    | 77              | 18·27     | 1 in 289     | Ascending.               |                     |
| 15                                               | 77              | 1                    | 27              |           |              | Level.                   |                     |
| 18                                               | $65\frac{1}{2}$ | 2                    | $68\frac{1}{2}$ | 21·72     | 1 in 243     | Ascending.               |                     |
| 19                                               | $12\frac{1}{2}$ | 0                    | 27              |           |              | Level.                   | Summit Level.       |
| 21                                               | $32\frac{1}{4}$ | 2                    | $19\frac{3}{4}$ | 20·54     | 1 in 257     | Descending               |                     |
| 21                                               | 45              | 0                    | $12\frac{3}{4}$ |           |              | Level.                   |                     |
| 21                                               | 71              | 0                    | 26              | 12·30     | 1 in 429     | Ascending.               | Salisbury Terminus. |

The earthworks are by no means heavy: the principal embankment, which is at Lockerley, is 1 mile 72 chains in



length, and averaging 16 feet in height ; the chief cutting is in Clarendon and Alderbury parishes, 1 mile 28 chains long, and averaging 24 feet in depth.

#### CROSSINGS OF ROADS, &c.

The crossings consist of three turnpike-roads, two to be passed over the railway and one under ; twenty-five highways and parish roads, eleven over, and fourteen under ; seven occupation roads, six over and one under ; thirteen brooks, streams, &c. ; six river crossings ; and one level crossing. The Andover Canal to be passed under the railway, at 17 feet below the rails' top surface, and the old canal to be thrice passed under.

#### REMARKS.

The whole length of this line is 21 miles 71 chains, and consists of five level and seven inclined planes ; the former of which amount in length to 4 miles 18 chains, and the gradients of the latter range from 23·15 feet per mile, or 1 in 228, to 11·73 feet in a mile, or 1 in 450. The summit is 19 miles 12½ chains from the Southampton Railway, and 2 miles 58½ chains from the intended Salisbury terminus, being 186 feet above the former, and 42 feet above the latter. Forty-five bridges will be required, according to the Parliamentary section, for roads, rivers, and canals, and thirteen bridges and culverts for brooks, streams, &c.

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### HARWICH RAILWAY.

WILLIAM HOSKING, Esq., Civil Engineer.

This line commences at the intended station of the Eastern Counties Railway, in Lexden parish, near Colchester, crosses the road from Colchester to Mile End and Bergholt ; thence passing through the parish of St. Michael, and 5 chains to the left of Dilbridge Farm House, in St. Botolph parish, continues



through Chop-wood and Welsh-wood, 11 chains to the right of the water-mill in Ardleigh parish, 10 chains to the right of the mansion in Ardleigh-park, passing through the plantation, and thence proceeding to and crossing Great Bromley-heath, close on the right of the pond, 12 chains to the left of Little Bromley Hall, 2 chains to the left of Bream Hall, cutting the corner of Marjoram's-wood on the left, 3 chains to the left of Dairy Farm, in Wick's parish, 11 chains to the left of Carbonel Hall, 2 chains to the left of Rayden Hall-buildings, 16 chains to the left of Ramsey-street,  $10\frac{1}{2}$  chains to the left of the Lord Nelson public-house in Ramsey parish; thence crossing Ramsey river, 28 chains from the bridge, and continuing within a quarter of a mile of Michaelstow Hall on the right,  $12\frac{1}{2}$  chains to the left of Dover Court Church,  $11\frac{1}{2}$  chains to the left of Bobbit's Hole, 9 chains to the left of the mill, 13 chains to the left of the battery; thence to the right of the Half Moon Battery, and terminating at the intended Harwich station, between Golden Lion-lane and the Trinity store-house.

## GRADIENTS, &amp;c.

Datum—Ten feet below the surface of wood sill of the Trinity Buoy Store-house, Harwich.

| Distance from Harwich. |                 | Length of each plane. |                 | Gradient. | Inclination. | Ascending or Descending. | Locations.                                             |
|------------------------|-----------------|-----------------------|-----------------|-----------|--------------|--------------------------|--------------------------------------------------------|
| Miles.                 | Chains.         | Ms.                   | Chs.            | Feet.     |              |                          |                                                        |
| 1                      | 0               | 1                     | 0               |           |              | Level                    |                                                        |
| 4                      | 0               | 3                     | 0               | 11·67     | 1 in 452     | Ascending                |                                                        |
| 6                      | 0               | 2                     | 0               | 13·       | 1 in 406     | Ascending                |                                                        |
| 9                      | 0               | 3                     | 0               | 13·50     | 1 in 391     | Ascending                | Near Bradfield Hall.                                   |
| 12                     | 0               | 3                     | 0               | 7·67      | 1 in 688     | Ascending                |                                                        |
| 14                     | 20              | 2                     | 20              | 4· 0      | 1 in 1320    | Ascending                |                                                        |
| 15                     | 4               | 0                     | 64              |           |              | Level                    | Welsh Wood Summit Level.                               |
| 16                     | 19              | 1                     | 15              | 10·53     | 1 in 501     | Descending               |                                                        |
| 17                     | $30\frac{1}{2}$ | 1                     | $11\frac{1}{2}$ | 4·37      | 1 in 1207    | Level                    | Junction with Eastern Counties' Railway at Colchester. |

The principal earthworks are, an embankment in the parishes of Bradford, Mistley, Little Bromley, Great Bromley,



and Ardleigh, which is  $5\frac{3}{4}$  miles in length, and averaging 8 feet in height, and a cutting in the parishes of St. Botolph and Greenstead, 1 mile 30 chains in length, and averaging 21 feet in depth.

#### CROSSINGS OF ROADS, &c.

There are seventeen highways and parish-roads to be crossed by the railway, fifteen to be passed over, and two under; six occupation-roads over; three rivers under, and six level crossings.

#### REMARKS.

The whole length of this line is 17 miles  $30\frac{1}{2}$  chains, and is arranged in nine planes, of which two are level for a collective length of 1 mile 64 chains, and the gradients of the others are extremely favourable, ranging from 13.50 to 4.37 feet per mile. The earthworks are not considerable.

The bridges required for roads, &c., to be passed over and under the railway, are twenty-six in number, and there are six level crossings, which will require a lodge and gates to each.

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## HYDE-PARK AND RICHMOND RAILWAY

JOHN TIERNEY CLARK, and JOHN BRAITHWAITE, ESQRS., Engineers.

This line commences 35 chains to the east of and intersects Knightsbridge Barracks, thence curving across the western road, just beyond the Half-way House, traverses Brompton-lane,  $6\frac{1}{2}$  chains to the left of Kensington Gore; thence passing through Kensington parish, across Earl's Court-road and the Kensington Canal, continues to North End, crossing King-



street, by the end of Brook Green-lane, and passing to the right of Bradmore-lane; thence crossing Webb's-lane, Raven's Court-park, and the New-road; thence curving through Chiswick and Ealing parishes, the branch to New Brentford diverging at the meeting of the Acton and Ealing roads; the main line crossing the River Thames, and passing through Kew and Richmond parishes to its termination in the latter.

## GRADIENTS, &amp;c.

| Distance from Knightsbridge. |         | Length of each Plane |       | Gradient. | Inclination. |      | Ascending or Descending. | Locations.                   |
|------------------------------|---------|----------------------|-------|-----------|--------------|------|--------------------------|------------------------------|
| Miles.                       | Chains. | Ms.                  | Chs.  | Feet.     |              |      |                          |                              |
| 0                            | 63·03   |                      | 63·03 | 12·69     | 1 in         | 416  | Descending               | Turnpike-road to Kensington. |
| 1                            | 30·75   |                      | 47·72 |           |              |      | Level                    | Gloucester-road.             |
| 2                            | 62·56   | 1                    | 31·81 | 8·58      | 1 in         | 615  | Descending               | Kensington-road.             |
| 4                            | 31·04   | 1                    | 48·48 | 1·98      | 1 in         | 2826 | Ascending                | New-road.                    |
| 5                            | 50·30   | 1                    | 19·26 | 15·26     | 1 in         | 346  | Descending               |                              |
| 6                            | 15·75   |                      | 45·45 | 17·60     | 1 in         | 300  | Ascending                | River Thames.                |
| 6                            | 40·15   |                      | 24·40 |           |              |      | Level                    | River Thames.                |
| 6                            | 65·90   |                      | 25·75 | 14·58     | 1 in         | 362  | Descending               |                              |
| 7                            | 57·57   |                      | 71·67 | 3·62      | 1 in         | 1455 | Ascending                | Richmond Terminus.           |

The branch to Brentford is 1 mile 2·27 chains in length, and rises towards that town at the rate of 8·30 feet per mile, or 1 in 638.

## PRINCIPAL EARTHWORKS.

| Description.      | Length in yards. | Average height or depth. | Locations.                |
|-------------------|------------------|--------------------------|---------------------------|
|                   |                  | Feet.                    |                           |
| Embankment .....  | 668 .....        | 12 .....                 | Hyde Park.                |
| Cutting .....     | 1333 .....       | 15 .....                 | Kensington Turnpike-road. |
| Embankment .....  | 6666 .....       | 17 .....                 | Kensington Canal.         |
| Cutting .....     | 1200 .....       | 13 .....                 | Road to Ealing.           |
| Two Embankments.. | 1000 .....       | 9 .....                  | River Thames.             |

The branch towards Brentford is in cutting, averaging about 7 feet in depth.

## CROSSINGS OF ROADS, &amp;c.

The crossings consist of two turnpike-roads to be passed over the railway; thirteen public-roads and highways, five to



be passed over, and eight under ; six footpaths ; and one occupation-road under. The Kensington Canal is to be passed 27, and the River Thames 16 feet below the rails' top surface.

#### REMARKS.

The whole length of this line is 7 miles  $51\frac{1}{2}$  chains, and consists of two level and seven inclined planes, the former amounting to 72·12 chains in length, and the latter having gradients varying from 17·60 to 1·98 feet per mile. The Kensington turnpike-road is to be passed over the railway at an elevation of 19 feet 6 inches, and the carriage-road into Hyde-park at 21 feet 6 inches above the top surface of the rails ; the railway to pass over the Thames at an elevation of 16 feet above the water's surface. Twenty-five bridges will be required for this railway, including that for the River Thames. Both the terminal planes are on an ascent to the stations respectively, which should, if possible, always be so arranged.

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### IPSWICH AND BURY SAINT EDMOND'S RAILWAY.

JOHN BRAITHWAITE, Esq., Engineer.

A railway connection between Ipswich and Bury is intended to be formed by means of a branch from Ipswich to the main line of the Eastern Counties' Railway, commencing in a field on the north side of the town, and extending in a curvilinear course for 1 mile and 9 chains, to its junction with that railway, thence running along that intended line, and diverging therefrom in the parish of Bilstead ; thence passing through Copdock and Washbrook parishes, crosses the road from



Sproughton to Hadleigh in Chattisham parish, and the road from Ipswich to Chattisham in Hintlesham parish; thence through Aldham, Whatfield, Naughton, and Nedging, and crosses the road from Ipswich to Bildestone; thence running nearly in a direct line across a slip of Wattisham parish, and through the parishes of Hitcham and Brettenham, and by means of a tunnel under the high ground in Felsham and Bradfield St. George parishes, continues its course to the left of Free Wood, and thence crossing Bradfield Green, and passing through Rushbrook and Rougham parishes, traverses the road from Ipswich to Bury, in St. Mary's parish, 36 chains from the bridge over the River Lark, crossing Shaker's Lane about 33 chains from its junction with the Ipswich and Bury Road, and terminating in a field lying between the River Lark and Shaker's Lane, near Bury St. Edmond's

#### CURVES.

The curves under three-quarters of a mile' radius are two of 43 chains in Hintlesham and Chattisham parishes; and two of 32 chains in the branches to form the junction with the Eastern Counties' Railway.

#### GRADIENTS, &c.

Datum—Trinity High Water Level.

| Distance from Junction with Eastern Counties' Railway. |         | Length of each plane. |      | Gradient. | Inclination. | Ascending or Descending. | Locations.                 |
|--------------------------------------------------------|---------|-----------------------|------|-----------|--------------|--------------------------|----------------------------|
| Miles.                                                 | Chains. | Ms.                   | Chs. | Feet.     |              |                          |                            |
| 2                                                      |         | 2                     |      | 13'       | 1 in 406     | Ascending                | Saint Mary's Parish, Bury. |
| 5                                                      |         | 3                     |      | 15.34     | 1 in 344     | Ascending                |                            |
| 7                                                      |         | 2                     |      | 3.50      | 1 in 1508    | Descending               |                            |
| 8                                                      | 20      | 1                     | 20   | 2.40      | 1 in 2200    | Ascending                |                            |
| 14                                                     | 73½     | 6                     | 53½  | 15.30     | 1 in 345     | Ascending                |                            |
| 16                                                     | 20      | 1                     | 26½  | 4.50      | 1 in 1171    | Descending               |                            |
| 23                                                     | 00      | 6                     | 60   | 15.42     | 1 in 342     | Descending               |                            |



The Ipswich Branch is 1 mile 9 chains long, and rises to the Eastern Counties' Railway at the rate of 8·09 feet in a mile, or 1 in 652.

There is a tunnel proposed  $1\frac{1}{4}$  miles in length and 23 feet high, in Felsham and Bradfield St. George parishes, and 50 feet below the surface of ground.

The earthworks mostly worthy of notice are an embankment of 1 mile 52 chains in length, in Hadleigh, Aldham, and Whatfield parishes, and averaging 26 feet in height; a cutting of two miles 5 chains in Hitcham and Brettenham parishes, 32 feet in depth, and a second in Broadfield and Rougham parishes, 2 miles 13 chains in length and 26 feet in depth.

#### CROSSINGS OF ROADS, &c.

There are two turnpike-roads proposed to be crossed, one to be passed over and the other under; twenty-three highways and parish-roads, thirteen over and ten under; nine occupation-roads, six over and three under, and two brooks.

#### REMARKS.

The whole length of this line is 23 miles, and consists of four planes, ascending towards Bury at the rate of from 15·34 to 2·40 feet per mile, and three descending in the same direction, with gradients varying from 15·42, to 3·50 feet per mile; the gradients therefore are very favourable.

The curves under three-quarters of a mile' radius are four in number. There is one tunnel a mile and a quarter in length and 23 feet in height. The earthworks are not very important. The bridges required for roads, &c. are thirty-four in number, and two culverts. The clear height allowed for road arches over the railway is 14 feet.



## IRELAND, SOUTH WALES, GLOUCESTER, CHELTENHAM, AND LONDON JUNCTION RAILWAY.

H. R. PALMER, ESQ., F.R.S., Engineer.

The main line leaves the Cheltenham and Great Western Railway, near Cold Pool Farm, passes through Badgeworth and Leckhampton parishes, crosses the turnpike-road from Cheltenham to Cirencester, in Charlton Kings parish; thence nearly in a direct line to Dowdeswell Wood, and passing under the high ground in Dowdeswell parish, by means of a tunnel, continues to and passes under Sandwell Park by another tunnel; thence 10 chains to the right of Whittington-court, 2 chains to the left of Andover Ford Inn,  $3\frac{1}{2}$  chains to the left of Owdeswell Farm,  $\frac{1}{2}$  a chain to the left of Frog Mill Inn; thence curving to Broadwell End, and passing the high ground beyond Withington, by a tunnel to the right of Compton Casey, through Chedworth Wood, across Yanworth Common; thence crossing Long Acre Wood and again through Chedworth Wood, 4 chains to the right of Yanworth Mill, 7 chains to the right of Foss Bridge, 6 chains to the right of Winson Mill, 3 chains to the right of Grove Barn; thence to Bibury, skirting Oxhill-lane on the left, to the right of Northerton, 12 chains to the left of Momes Leaze Farm,  $12\frac{1}{2}$  chains to the left of Titups; thence through Southrop, 9 chains to the left of Oxleaze Farm, through Langford parish; thence crossing Grafton Field and Grafton Common, and skirting Tawney Field, across Fore Meadow and Rye Meadow, 17 chains to the left of Old Man's Weir on the River Thames; thence crossing that river and entering the County of Berks, and continuing to within 12 chains of Marsh Farm on the right; thence to Tadpole, and 10 chains to the right of Lower Newton Farm, 1 chain to the right of Westfield Wood, 3 chains to the left of Longworth Lodge, across South Moor Common Field, close to New Barn in Garford parish, 5 chains to the left of Ven Mill, crossing the Berks and Wilts Canal in



Drayton parish, and passing through the Common Field; thence to Steventon, and joining the Great Western Railway at Milton.

The branch to Cheltenham crosses the Birdlip and Cheltenham-road, and curving to the left thereof, terminates in the General Hospital Ground of that town.

There is a curve of 16 chains' radius in this branch near its junction with the main line.

# GRADIENTS, &c.

Datum—486 feet below the crown of the Arch of the Bridge over the River Colne at Frog Mill.

| Distance from Junction with Cheltenham & Great Western Railway. |         | Length of each Plane |      | Gradient. | Inclination. | Ascending or descending. | Locations.                                     |
|-----------------------------------------------------------------|---------|----------------------|------|-----------|--------------|--------------------------|------------------------------------------------|
| Miles.                                                          | Chains. | Ms.                  | Chs. | Feet.     |              |                          |                                                |
| 0                                                               | 41½     | 0                    | 41½  |           |              | Level                    |                                                |
| 2                                                               | 12      | 1                    | 50½  | 80·       | 1 in 66      | Ascending                |                                                |
| 3                                                               | 20¼     | 1                    | 8¼   | 1·88      | 1 in 2800    | Descending               | Near Turnpike-road to Cirencester.             |
| 5                                                               | 31¾     | 2                    | 11½  | 132·      | 1 in 40      | Ascending                | Tunnel in this plane.                          |
| 6                                                               | 32¾     | 1                    | 1    | 6·75      | 1 in 782     | Descending               | Tunnel in this plane.                          |
| 7                                                               | 9¼      | 0                    | 57   |           |              | Level                    | Road from Stow to Gloucester.                  |
| 7                                                               | 77      | 0                    | 67¼  | 15·66     | 1 in 337     | Descending               | River Colne at Frog Mill.                      |
| 8                                                               | 33      | 0                    | 36   |           |              | Level                    | River Colne.                                   |
| 9                                                               | 73      | 1                    | 40   | 13·16     | 1 in 401     | Descending               | Entrance to Tunnel.                            |
| 10                                                              | 32¾     | 0                    | 39¾  |           |              | Level                    | Tunnel in this plane.                          |
| 13                                                              | 12¼     | 2                    | 59½  | 16·24     | 1 in 325     | Descending               |                                                |
| 14                                                              | 11      | 0                    | 78¾  | 2·79      | 1 in 1889    | Descending               |                                                |
| 15                                                              | 11½     | 1                    | 0½   | 13·26     | 1 in 398     | Descending               |                                                |
| 16                                                              | 12      | 1                    | 0½   | 7·95      | 1 in 664     | Descending               |                                                |
| 17                                                              | 13¼     | 1                    | 1¼   | 7·88      | 1 in 670     | Descending               | Turnpike-rd. from Bibury to Cirencester.       |
| 18                                                              | 13¾     | 1                    | 0½   | 11·68     | 1 in 452     | Descending               |                                                |
| 26                                                              | 12      | 7                    | 78¼  | 16·34     | 1 in 323     | Descending               |                                                |
| 28                                                              | 14      | 2                    | 2    | 13·46     | 1 in 392     | Descending               |                                                |
| 28                                                              | 54      | 0                    | 40   | 15·52     | 1 in 340     | Descending               |                                                |
| 30                                                              | 19      | 1                    | 45   | 2·24      | 1 in 2357    | Ascending                | River Thames.                                  |
| 30                                                              | 77½     | 0                    | 58½  | 10·27     | 1 in 514     | Descending               |                                                |
| 31                                                              | 77½     | 1                    | 0    | 4·25      | 1 in 1242    | Descending               | Turnpike-rd. from Faringdon to Bampton.        |
| 34                                                              | 77½     | 3                    | 0    | 6·42      | 1 in 822     | Ascending                |                                                |
| 37                                                              | 37      | 2                    | 39½  | 13·85     | 1 in 381     | Descending               |                                                |
| 38                                                              | 38      | 1                    | 1    | 12·60     | 1 in 419     | Descending               | Turnpike-road from Wantage to Oxford.          |
| 39                                                              | 19      | 0                    | 61   | 5·13      | 1 in 1029    | Descending               |                                                |
| 39                                                              | 64      | 0                    | 45   | 1·77      | 1 in 2970    | Descending               |                                                |
| 42                                                              | 51      | 2                    | 67   |           |              | Level                    | Junction with Great Western Railway at Milton. |



The Cheltenham branch consists of two planes, the first descending towards that Town at the rate of 17·25 feet per mile, or 1 in 306, for a length of  $69\frac{1}{2}$  chains; and the second level for a length of  $79\frac{1}{2}$  chains.

## TUNNELS.

| Length    | Height.  | Under Summit. | Inclination.  | Locations.       |
|-----------|----------|---------------|---------------|------------------|
| Yards.    | Feet.    | Feet. Inches. |               |                  |
| 770 ..... | 25 ..... | 136 6 .....   | 1 in 42 ..... | Dowdeswell Wood. |
| 687 ..... | 25 ..... | 42 0 .....    | 1 in 754 ..   | Sandwell Park.   |
| 605 ..... | 25 ..... | 106 0 .....   | Level. ....   | Withington.      |

## PRINCIPAL EARTHWORKS.

| Description.   | Length.  | Greatest height<br>or depth. | Average height<br>or depth. | Locations.                          |
|----------------|----------|------------------------------|-----------------------------|-------------------------------------|
|                | Ms. Chs. | Feet.                        | Feet.                       |                                     |
| Embankment     | 70 ..... | 74 .....                     | 35 ...                      | Near end of Dowdeswell Tunnel.      |
| Cutting .....  | 22 ..... | 72 .....                     | 63 ...                      | West-end of Sandwell Tunnel.        |
| Cutting . ...  | 34 ..... | 73 .....                     | 45 ...                      | Road Cirencester to Compton.        |
| Cutting .... 3 | .....    | 46 ...                       | 22 ..                       | Momes Leaze.                        |
| Embankment 3   | 20 ..... | 25 .....                     | 15 ...                      | Grafton Common.                     |
| Cutting .... 1 | 47 ..... | 52 .....                     | 22 ...                      | Faringdon and London Turnpike-road. |

## CROSSINGS OF ROADS, &amp;c.

There are eleven turnpike-roads proposed to be crossed by this railway, eight to be passed over and three under; forty-four highways and parish roads, eighteen over and twenty-six under; seven occupation-roads, two over and five under; and thirty-two brooks, streams, &c. The River Colne to be passed over by the railway eleven times, and the River Thames once, at an elevation of 15 feet above the water's surface. The Berks and Wilts Canal to pass under the Railway, 15 feet below the surface of rails. The turnpike-road to London, between the sixth and seventh mile from the proposed Western terminus, to be diverted for half a mile.



## REMARKS.

The main line is 42 miles 51 chains in length, and consists of five level planes, amounting in length to 5 miles  $1\frac{1}{4}$  chains, and twenty-three inclined planes, whose gradients range from 132 to 1·77 feet per mile; of these latter, two at the western part of the line, will require stationary engines, the one rising at the rate of 1 in 66, or 80 feet in a mile, for 1 mile  $50\frac{1}{2}$  chains; the other 1 in 40, or 132 feet in a mile, for 2 miles  $11\frac{1}{2}$  chains. The steepest locomotive plane falls at the rate of 16·34 feet per mile, or 1 in 323: no assistant engines therefore will be required.

The length of the Cheltenham branch is 1 mile 69 chains, more than half of which is level, and the rest falling at the rate of 17·25 feet per mile or 1 in 306. The tunnelling amounts in length to 2062 yards, or one mile one furlong and 82 yards. The deepest vertical shaft for executing the tunnel works is under 130 feet. The heaviest embankment is at Grafton Common, extending for a length of three-quarters of a mile, and averaging 22 feet in height: and the principal cutting is that at Momes Leaze, being three miles in length, and averaging 22 feet in depth.

The bridges required for roads, rivers, and canals, &c. are seventy-five in number; and culverts and bridges for brooks, streams, &c., thirty-two. The height allowed for passing turnpike-roads under the railway, is 14 feet 9 inches, allowing 3 feet 6 inches for the arch and railway formation; and 11 feet 6 inches for arches above the railway, supposing the same dimension as above from the soffite to the surface of the road. Horizontal iron beams with road plates may be used, in cases where but little elevation can be obtained; but the adoption of this system necessarily limits the space of the openings.

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## KENT RAILWAY.

JAMES WALKER, F.R.SS. L. and E., and A. BURGESS, ESQRS., Engineers.

This line is intended to form a Grand Trunk through the populous Towns of East Kent. It leaves the station of the Greenwich Railway, and the intended Westminster and Deptford Railway, at High-street, Deptford, and runs on the right and close beside this Viaduct to its termination near Bexley-place, Greenwich; thence continuing across London-street, Royal-hill, Croomes-hill, and running under Greenwich-park, pursues a course close without the line of wall of St. Mary's Church-yard and of that of the Royal Naval Asylum; thence across Maize-hill, and nearly in a direct line to Woolwich, and crossing in its passage through this Town, Samuel-street, Henry-street, Brewer-street, Upper Market-street, Lower Market-street, Wellington-street, the New-road, Taylor's-buildings, Helen-street, and East-street; thence passing a quarter of a mile to the left of Plumstead Church, 12 chains to the left of the Harrow Public-house, in Earith Parish, and curving to within 6 chains of the Church on the left; thence passing 1 chain to the left of Wall House Farm, crossing Dartford Creek, and continuing its course to within a quarter of a mile of Stone on the right; thence passing on to Greenhithe, a quarter of a mile to the right of Galley-hill, 16 chains to the right of North Fleet Church, 22 chains to the right of the Windmill at Gravesend, 22 chains to the left of Chalk Village, and 10 chains to the right of the Church, a quarter of a mile to the left of the Beef Steak House, 6 chains to the right of Brickham Farm, 7 chains to the left of Groundsill Wood, passing within 4 chains and on the right of the middle of the Thames and Medway Tunnel, 8 chains to the left of the Hermitage, 9 chains to the left of Brompton Farm; thence 25 chains to the right of Strood Church, crossing the river Medway at Rochester, and passing to the left of Clarence



Fort, and to the right of Fort Pitt; thence crossing Fort-row, and running between Caroline-street and New Inn-street, 5 chains to the left of the Windmill, 17 chains to the left of Westwood Farm, 18 chains to the left of Macknade Toll Gate, 8 chains to the right of Cokin's, 15 chains to the left of Dane's-court, and 27 chains to the right of Boughton Church, 9 chains to the right of Rhodes Court Farm,  $1\frac{1}{2}$  chains to the left of Stone Stile Farm; thence curving within 21 chains of Chilham Church on the right, passing to White-hill, and crossing the river Stour, near Shalmsford-street, which is again crossed 25 chains beyond; thence 3 chains to the left of Chartham Church, 32 chains to the left of Horton Chapel, 2 chains to the left of Howfield Farm, 13 chains to the right of Tunford Farm, 1 chain to the right of Whitehall; thence proceeding to Canterbury, and crossing St. Dunstan's-street  $4\frac{1}{4}$  chains to the left of Kirby's-lane, and the Canterbury and Whitstable Railway, 5 chains to the left of the station, continuing within 13 chains and to the left of Barton Mill; thence passing close on the right of Fordwich, 11 chains from the Church on the left, 3 chains to the right of Paxton, 8 chains to the left of Stodmarsh-court, 10 chains to the right of West-court Farm Buildings, close on the right of Woodland Farm, a quarter of a mile to the left of Burying Grave, 38 chains to the left of Rainham, 10 chains to the left of Mackland Farm, 38 chains to the left of Moor-street, a quarter of a mile to the right of Gore and Boxted Farms; thence through Breach Wood, 11 chains to the left of Newington Church, passing through Wardwell Wood, 3 chains to the left of Cold Harbour, 4 chains to the right of Pigeon Farm, 5 chains to the left of Rose Hill, 10 chains to the left of Road House, 9 chains to the left of Sittingbourne and Church, 6 chains to the right of Bayford Farm; thence running parallel with the turnpike-road, and 4 chains to the right of Stone Farm, 10 chains to the left of Bapchild-street,  $1\frac{1}{2}$  chains to the right of Hemsted Court Farm, 10 chains to the left of Radfield, 13 chains to the left of Green-



street, 12 chains to the left of New Gardens Farm, a quarter of a mile to the left of Norton Toll Gate, 10 chains to the left of the ruins of Stone Chapel,  $4\frac{1}{2}$  chains to the left of Ospringe Windmill, leaving Ospringe on the left, 6 chains to the left of Perry Farm, crossing the isolated portion of Luddenham parish, 11 chains to the left of Stodmarsh Church, 4 chains to the right of Undertrees, 16 chains to to the left of Preston, 12 chains to the left of Santon Farm, 23 chains to the left of Barston Farm; thence slightly curving to Weatherless Hill, and passing 10 chains to the left of Ebbs Fleet, crossing Pegwell Bay for rather more than a quarter of a mile, and then running nearly in a right line to Ramsgate and terminating at the intended depôt behind the houses in Trafalgar-place.

The Dovor line leaves the main, by two branches, in the parish of Ash, each branch passing within about 10 chains of Guston-court, and meeting together near the road from Brook-street; thence crossing the road from Canterbury to Sandwich, and passing 17 chains to the right of the Windmill, and 17 chains to the left of Polder's Farm, continues to Worth; thence nearly in a direct line to the point in Deal parish, where the proposed branch to that town diverges from the main line; the Dovor line continues a quarter of a mile to the right of Walmer Castle, passing thence to Kingsdown and skirting the sea shore, to the proposed station near Dovor Castle.

#### CURVES.

There is a curve at Strood of three-quarters of a mile' radius, and those of less curvature than three-quarters of a mile are in the Deal Branch; one of 40, the other of 14 chains' radius.



GRADIENTS, &c.

Datum—Trinity High Water.

| Distance from<br>Deptford. |         | Length of<br>each Plane |      | Gra-<br>dient. | Inclina-<br>tion. | Ascending or<br>Descending. | Locations.                                 |
|----------------------------|---------|-------------------------|------|----------------|-------------------|-----------------------------|--------------------------------------------|
| Miles.                     | Chains. | Ms.                     | Chs. | Feet.          |                   |                             |                                            |
| 0                          | 6       | 0                       | 6    |                |                   | Level                       |                                            |
| 0                          | 57½     | 0                       | 51½  | 34·06          | 1 in 155          | Descending                  | London-road.                               |
| 1                          | 78      | 1                       | 29½  | 5·11           | 1 in 1032         | Ascending                   | Near Road from Lee                         |
| 3                          | 75      | 1                       | 17   | 15·71          | 1 in 336          | Ascending                   |                                            |
| 4                          | 78      | 1                       | 63   | 16·24          | 1 in 325          | Descending                  | Turnpike-road to<br>Plumpstead.            |
| 8                          | 78      | 4                       | 0    |                |                   | Level                       |                                            |
| 10                         | 66      | 1                       | 68   | 8·11           | 1 in 651          | Ascending                   | Dartford Creek.                            |
| 11                         | 66      | 1                       | 0    | 15·            | 1 in 352          | Descending                  |                                            |
| 13                         | 78      | 2                       | 12   | 13·03          | 1 in 405          | Ascending                   | Tram Road.                                 |
| 18                         | 0       | 4                       | 2    | 6·46           | 1 in 817          | Ascending                   | Road to Gravesend.                         |
| 23                         | 0       | 5                       | 0    | 14·83          | 1 in 356          | Ascending                   |                                            |
| 26                         | 0       | 3                       | 0    | 16·            | 1 in 330          | Descending                  | River Medway.                              |
| 29                         | 0       | 3                       | 0    | 16·            | 1 in 330          | Ascending                   |                                            |
| 29                         | 40      | 0                       | 40   |                |                   | Level                       |                                            |
| 33                         | 60      | 4                       | 20   | 16·            | 1 in 330          | Descending                  | Near Road to Newington                     |
| 35                         | 0       | 1                       | 20   | 16·            | 1 in 330          | Ascending                   | Near Road to Norwood<br>Farm.              |
| 38                         | 41½     | 3                       | 41½  | 15·95          | 1 in 331          | Descending                  | Near Tonge Lane.                           |
| 43                         | 0       | 4                       | 38½  | 10·27          | 1 in 514          | Ascending                   | Near Turnpike-road to<br>Sittingbourne.    |
| 47                         | 0       | 4                       | 0    | 15·            | 1 in 352          | Ascending                   | Near Road to South-st.                     |
| 48                         | 0       | 1                       | 0    |                |                   | Level                       |                                            |
| 51                         | 78      | 3                       | 78   | 16·14          | 1 in 327          | Descending                  |                                            |
| 55                         | 0       | 3                       | 2    | 6·94           | 1 in 760          | Descending                  | Near Canterbury and<br>Whitstable Railway. |
| 57                         | 50      | 2                       | 50   | 15·26          | 1 in 346          | Descending                  |                                            |
| 61                         | 22      | 3                       | 52   |                |                   | Level                       | Little Stour River.                        |
| 62                         | 60      | 1                       | 38   | 3·39           | 1 in 1557         | Descending                  |                                            |
| 66                         | 0       | 3                       | 20   |                |                   | Level                       |                                            |
| 70                         | 11      | 4                       | 11   | 15·95          | 1 in 331          | Ascending                   | Ramsgate Terminus.                         |

The extension line to Dovor, including the South Branch, is 17 miles 16 chains in length, and nearly level.

TUNNELS.

| Length.<br>Yards. | Height.<br>Feet. | Depth below surface.<br>Feet. | Locations.          |
|-------------------|------------------|-------------------------------|---------------------|
| 649 .....         | 25 .....         | 95 .....                      | Gillingham.         |
| 225 .....         | 25 .....         | 90 .....                      | Buckland and Stone. |
| 682 .....         | 25 .....         | 115 .....                     | Selling.            |
| 858 .....         | 25 .....         | 85 .....                      | Walmer.             |



## PRINCIPAL EARTHWORKS.

| Description.  | Length. |      | Greatest height<br>or depth. |     | Average height<br>or depth. |    | Locations.              |
|---------------|---------|------|------------------------------|-----|-----------------------------|----|-------------------------|
|               | Ms.     | Chs. | Feet.                        |     | Feet.                       |    |                         |
| Cutting ..... |         | 75   | ....                         | 56  | .....                       | 38 | Swanscombe.             |
| Cutting ..... | 1       | 20   | ....                         | 82  | .....                       | 48 | Friendsbury and Strood. |
| Embankment    |         | 50   | ....                         | 90  | .....                       | 50 | Strood.                 |
| Cutting ..... | 2       | 30   | ...                          | 83  | .....                       | 46 | Gillingham.             |
| Embankment    | 1       | 50   | ....                         | 50  | .....                       | 37 | Rainham.                |
| Cutting ..... | 1       | 20   | ....                         | 109 | .....                       | 45 | Selling.                |
| Cutting ..... | 1       | 33   | ....                         | 100 | .....                       | 48 | Selling and Chilham.    |
| Cutting ..... |         | 67   | ....                         | 77  | .....                       | 48 | St. Lawrence, Ramsgate. |

## CROSSINGS OF ROADS, &amp;c.

The crossings consist of seventeen turnpike-roads, ten to be passed over and seven under the railway ; one hundred and thirty-nine highways and parish roads, ninety-three over and forty-six under ; eighty-one foot-paths, thirty-four brooks, streams, &c. ; one canal, one tramway, and the Canterbury and Whitstable Railway, which is 15 feet under ; and sixteen level crossings.

The rivers to be crossed over by the railway are the Medway, at an elevation of 92, the Ravensbourne at 17, and Dartford Creek, at 15 feet elevation above the water's surface at each crossing respectively. The Old Back River, and the Little Stour, each to be passed under the railway, and the River Stour four times.

## REMARKS.

The whole length of the line from Deptford to Ramsgate is 70 miles 11 chains, and the distance from the former place to Dover, 80 miles 33 chains. The characteristic gradient is about 16 feet in a mile ; the other inclinations of the main line range from 1 in 330 to 1 in 1557, except one plane at Greenwich, which is  $51\frac{1}{2}$  chains long, and descends to the London-road at the rate of 1 in 155, or 34.06 feet in a mile ;



and there are six level planes, amounting together in length to 12 miles 38 chains. There are two curves each of less radius than three-quarters of a mile.

The tunnelling amounts to 1 mile 654 yards. Greenwich Park may be passed either by a tunnel or by open cutting between retaining walls, surmounted with ballustrades.

The chief embankment is at Rainham, 1 mile 5 furlongs in length, and averaging about 37 feet in height, and the most important cutting is at Gillingham, two miles and three furlongs in length, and averaging 46 feet in height.

The viaduct proposed to cross the Medway is upwards of 2,000 feet in length, and about 85 feet in height, and that at Chatham about 720 feet in length, and averaging 75 feet in height.

The bridges required for roads, &c., are two hundred and forty-nine in number, including the Medway and Chatham viaducts, and the smaller bridges and culverts for brooks, streams, &c., thirty-four in number.

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## LANCASTER AND PRESTON RAILWAY.

JOSEPH LOCKE, Esq., Engineer.

This line commences on the south side of the cotton-mills, north of the Preston turnpike-road, Lancaster, and passes west of the Greaves, 11 chains west of Scotforth, between the Preston turnpike-road and Five Ashes, 7 chains to the east of the latter; thence between Ellel Hall estate and the silk-mill at Galgate, 5 chains to the east of Lane House, 6 chains to the west of Hampson-green, 5 chains to the east of Hole of Ellel, 3 chains to the west of Foxholes, within 2 chains and to the east of Hollin's-lane, crossing the River Wyre 4 chains to the west of the wooden bridge, and thence passing through Wood-acre Great-wood, 9 chains to the east



of Wood-acre Hall, 13 chains to the west of Brook's Barn, approaching the Lancaster Canal, near the canal stables, and again near Town Croft, within 4 chains and to the east of the Green Man Inn,  $1\frac{1}{2}$  chains east of Anderton Fold, crossing the Preston turnpike-road, about 6 chains to the south of the White Horse Inn,  $1\frac{1}{2}$  chains to the east of Hesketh Houses, within 2 chains east of Crow Hall, 17 chains east of Lightforth Houses, and the same distance from Ingol Head on the west, 6 chains east of Cadeley Mills, and continuing within 7 chains of the limekilns, on the west, in the parish of Preston, near the Lancaster Canal; thence crossing Kirkham road, the Preston and Wyre Railway, Bridge-lane, Lower Pill-street, and Dock-street, and proceeding to its junction with the North Union Railway, on the south side of Fishergate, Preston.

## CURVES.

The curves under three-quarters of a mile' radius are, one of 17 chains at Preston Terminus, and one of half a mile at the Lancaster Terminus.

## GRADIENTS, &amp;c.

Datum—Level of the sea at low water.

| Distance from Lancaster. |                 | Length of each plane. |                 | Gradient. | Inclination. | Ascending or descending. | Locations.                         |
|--------------------------|-----------------|-----------------------|-----------------|-----------|--------------|--------------------------|------------------------------------|
| Miles.                   | Chains.         | Ms.                   | Chs.            | Feet.     |              |                          |                                    |
| 1                        | $35\frac{3}{4}$ | 1                     | $35\frac{3}{4}$ | 10·37     | 1 in 509     | Ascending                |                                    |
| 3                        | $25\frac{1}{4}$ | 1                     | $69\frac{1}{2}$ | 6·42      | 1 in 822     | Descending               |                                    |
| 6                        | $14\frac{1}{4}$ | 2                     | 69              |           |              | Level                    |                                    |
| 12                       | $58\frac{3}{4}$ | 6                     | $44\frac{1}{2}$ | 3·96      | 1 in 1331    | Descending               |                                    |
| 17                       | 14              | 4                     | $35\frac{1}{4}$ | 6·92      | 1 in 762     | Ascending                |                                    |
| 20                       | 30              | 3                     | 16              | 10·56     | 1 in 500     | Descending               |                                    |
| 20                       | $38\frac{1}{4}$ |                       | $8\frac{1}{4}$  | 42·24     | 1 in 125     |                          | Junction with North Union Railway. |

The principal embankment is at Garstang,  $1\frac{1}{2}$  miles in length, and averaging 12 feet in height. The principal cutting is near the same place,  $2\frac{1}{4}$  miles in length, and averaging 16 feet in depth.



## CROSSINGS OF ROADS, &amp;c.

The turnpike-roads to be crossed by this railway are six in number, three to be passed over and three under; twenty-nine highways and parish-roads, twelve over and seventeen under; eleven occupation-roads, nine over and two under; thirty brooks, streams, &c. The Lancaster Canal to be passed under the railway 15 feet 6 inches below the rails' top surface.

The Wyre Railway to be raised about five feet, and crossed on the level; and the Lancaster Canal Company's Railway to be passed under.

The rivers to be passed over by the railway are the Conder, the Cocker, the Wyre, the Calder, and the Brock.

## REMARKS.

The whole length of this line is 20 miles  $38\frac{1}{4}$  chains, and is arranged in one level and seven inclined planes; the former is 2 miles 69 chains in length, and the latter vary in point of inclination from 1 in 125 to 1 in 1331. The plane inclining at the rate of 1 in 125, or 42.24 feet per mile, is the terminal plane at Preston, at the junction with the North Union Railway; it is, however, only  $8\frac{1}{4}$  chains in length, and therefore is of little moment.

The curves under three quarters of a mile radius are two in number.

The earthworks are not heavy.

The bridges required for rivers, &c. are fifty-three; and the culverts and bridges for streams, &c. thirty in number. According to the section lodged with the Clerk of the Peace, there are no level crossings.



**LONDON AND BRIGHTON RAILWAY.**

(Known as the direct line.)

SIR JOHN RENNIE, F.R.S. Engineer.

This line leaves the Croydon Railway, about 50 chains from the town of Croydon, continues through Croydon parish, crosses the proposed south-eastern railway in Sanderstead parish; thence through Carlsden parish, and passing to the village of Merstham, beyond which the Reigate Branch diverges; thence 11 chains to the left of Somer's Arms Inn, across Earl's Wood Common, 16 chains to the left of Petridge Wood Common, and nearly in a direct line through Hosley and Charlwood parishes; thence entering the county of Sussex, and passing through Worth parish, to the right of Cinder Bushes, a quarter of a mile to the right of Green Trees, near which is a tunnel, in a curve of about a mile radius; thence a quarter of a mile to the left of Cooper's Corner, and curving through Balcombe, 3 chains to the right of Ardingley Barn, 8 chains to the left of Ludgate's Farm, and across the west portion of Hayward's Heath, 8 chains to the left of Folly Farm; thence through Keymer parish, 8 chains to the left of Hassock's Gate, 4 chains to the right of Clayton Church, and by a tunnel under high ground near Clayton and Piecomb Churches, 7 chains to the right of Pangdean, passing to the right of Patcham Church, close on the right of Withdean; thence to Preston, 14 chains to the right of the Church, and pursuing a slightly-curving course to Brighton.

**REIGATE BRANCH.**

This branch leaves the main line near the village of Merstham, and passes through Gatton and Merstham parishes, terminating near Great Dood's, Reigate.



## LEWES BRANCH.

This branch leaves the main line at Brighton, and curves through Preston parish, 9 chains to the left of the Preston and Hove Water-works; thence to Mousecombe, 12 chains to the left of Holshrove Farm; thence passing under the high ground at Falmer by a tunnel, 6 chains to the right of House Dean, 34 chains from which the Newhaven Branch diverges, and a second branch to near the road to Kingston; thence 10 chains to the left of Winterbourne, 5 chains to the left of St. Ann's Church, and terminating at the River Ouse, Lewes.

## BRANCH TO THE SOUTH-EASTERN RAILWAY.

This branch leaves the main line about 10 chains from Merstham Church; thence passing to Chaldon, and through Bletchingley parish, and 15 chains to the right of Godstone Green; thence through Tandridge parish, to its junction with the South-Eastern Railway in the parish of Oxted.

## NEWHAVEN BRANCH.

This branch leaves the main line by two curved lines meeting together, and passing to Kingston; thence through the parish of Iford, 2 chains to the right of North Ease Farm, close on the left of Rodmill Windmill; thence to Southcombe, 3 chains to the left of Dean's Farm, 16 chains to the right of Peddinghoe Church, 15 chains to the left of Newhaven Church, and terminating at the River Ouse, Newhaven.

## BRANCH TO SHOREHAM AND WEST-END OF BRIGHTON.

This branch leaving the main line passes through the parishes of Hove and Aldrington; thence through Portslade and Kingston, and terminates at the intended station in Old Shoreham parish.

## CURVES.

The curves under  $\frac{3}{4}$  of a mile' radius are, one at Brighton in



the Lewes Branch,  $\frac{1}{4}$  of a mile, and a second at Mousecombe of 50 chains'.

In the Newhaven branch two of  $\frac{1}{4}$  of a mile' radius each, and leaving main line in Shoreham branch, one of a  $\frac{1}{4}$  of a mile' radius.

#### GRADIENTS, &c., OF MAIN LINE.

Datum—Trinity High Water Level.

| Distance from Croydon. |                  | Length of each Plane |                  | Gradient. | Inclination. | Ascending or Descending. | Locations.                                                           |
|------------------------|------------------|----------------------|------------------|-----------|--------------|--------------------------|----------------------------------------------------------------------|
| Miles.                 | Chains.          | Ms.                  | Chs.             | Feet.     |              |                          |                                                                      |
| 8                      | 61 $\frac{1}{2}$ | 8                    | 61 $\frac{1}{2}$ | 19·92     | 1 in 265     | Ascending                | Merstham Tramway.<br>Near turnpike-road to Cuckfield.                |
| 16                     | 10               | 7                    | 28 $\frac{1}{2}$ | 20·       | 1 in 264     | Descending               |                                                                      |
| 18                     | 40               | 2                    | 30               | 9·68      | 1 in 545     | Ascending.               | Road to Green Trees.                                                 |
| 22                     | 46               | 4                    | 6                | 20·       | 1 in 264     | Descending               |                                                                      |
| 27                     | 00               | 4                    | 34               | 20·       | 1 in 264     | Descending               |                                                                      |
| 31                     | 00               | 4                    | 00               | 13·50     | 1 in 391     | Descending               |                                                                      |
| 33                     | 00               | 2                    | 00               |           |              | Level                    | Near Hickstead turnpike-road.<br>North-lane, Brighton Church-street. |
| 36                     | 52 $\frac{1}{2}$ | 3                    | 52 $\frac{1}{2}$ | 20·       | 1 in 264     | Ascending.               |                                                                      |
| 41                     | 53               | 5                    | 00 $\frac{1}{2}$ | 20·       | 1 in 264     | Descending               |                                                                      |
| 41                     | 59               |                      | 06               |           |              | Level                    |                                                                      |

#### GRADIENTS, &c. OF BRANCHES.

The Shoreham branch is 5 miles 68 chains in length, and descends for 5 miles 28 $\frac{1}{2}$  chains at the rate of 1 in 264, and the remainder is level.

The Western branch to Hove is 44 chains in length, and falls from the main line at the rate of 1 in 264.

The Newhaven branch is 6 miles 75 chains long, and has two level and two inclined planes, the former amount in length to 1 mile 4 chains, and the inclinations of the latter are 1 in 267, and 1 in 257.

The Lewes branch is 7 miles 66 chains in length, and is arranged in three level and three inclined planes; the former amount in length to 1 mile 11 chains, and the inclinations of the latter vary from 1 in 50 to 1 in 269.

The Reigate branch is 2 miles 33 chains in length, and has



two planes ; the first descending from the main line, at the rate of 1 in 264, or 20 feet in a mile, and the other, at 1 in 2524, or 2·09 feet per mile.

The length of the branch to the South-eastern Railway is 7 miles 25 chains, and consists of two planes ; the first ascending from the main line at the rate of 1 in 586, and the latter descending to the south-eastern line, at the rate of 1 in 288.

TUNNELS.—MAIN LINE.

| Length.<br>Yrds. | Height.<br>Feet. | Inclination.   | Under Surface.<br>Feet. | Locations.    |
|------------------|------------------|----------------|-------------------------|---------------|
| 470 .....        | 30 ...           | 1 in 264 ..... | 166 .....               | Hand Cross.   |
| 850 .....        | 30 .....         | 1 in 264 ..... | 168 .....               | Clayton Hill. |

LEWES BRANCH.

|           |          |                |           |         |
|-----------|----------|----------------|-----------|---------|
| 875 ..... | 30 ..... | 1 in 264 ..... | 133 ..... | Falmer. |
| 150 ..... | 25 ..... | 1 in 50 .....  | 36 .....  | Lewes.  |

NEW HAVEN BRANCH.

|           |          |          |                       |
|-----------|----------|----------|-----------------------|
| 120 ..... | 30 ..... | 78 ..... | Road to<br>Baldsdean. |
|-----------|----------|----------|-----------------------|

PRINCIPAL EARTHWORKS.—MAIN LINE.

| Description.  | Length.<br>Ms. Chs. | Greatest height<br>or depth.<br>Feet. | Average height<br>or depth.<br>Feet. | Locations.                         |
|---------------|---------------------|---------------------------------------|--------------------------------------|------------------------------------|
| Cutting.....  | 0 60                | 46                                    | 24                                   | Parish Road to Beckenham.          |
| Cutting.....  | 3 38                | 118                                   | 60                                   | Merstham.                          |
| Embankment    | 70                  | 50                                    | 38                                   | At 13 Miles.                       |
| Embankment    | 3 40                | 34                                    | 10                                   | Between 14 and 19 miles.           |
| Cutting.....  | 44                  | 108                                   | 38                                   | By Hand Cross Tunnel.              |
| Cutting.....  | 79                  | 110                                   | 45                                   | South-end of same.                 |
| Embankment    | 1 4                 | 84                                    | 32                                   | River Ouse.                        |
| Cutting ..... | 34                  | 78                                    | 46                                   | Beyond 27 miles.                   |
| Cutting.....  | 62                  | 61                                    | 40                                   | Turnpike-road from Cuck-<br>field. |
| Embankment    | 1 14                | 69                                    | 30                                   | Road at Valebridge.                |
| Embankment    | 1 40                | 46                                    | 27                                   | Turnpike-road to Ditchling.        |
| Cutting.....  | 45                  | 128                                   | 52                                   | By Clayton Hill Tunnel.            |
| Cutting.....  | 2 15                | 132                                   | 52                                   | South-end of same.                 |
| Cutting.....  | 39                  | 98                                    | 44                                   | 39 miles.                          |



The principal earthworks of the Lewes branch are an embankment at Lewes, 55 chains long, and of the average height of 39 feet, and a cutting at Falmer, 69 chains long, and 50 feet average depth.

In the Reigate branch there is an embankment  $1\frac{1}{2}$  miles long, and averaging 14 feet high, at junction with main line, and a cutting 58 chains long, and 32 feet deep, at Linkfield-street.

In the Shoreham branch there is a cutting 1 mile 4 chains in length, and averaging 30 feet in depth, at junction with the main line.

In the Newhaven branch the chief earthworks are an embankment at the road to Rottingdean, 1 mile 10 chains in length, and averaging 34 feet in height, and a cutting at road to Lewes, 53 chains in length, and averaging 32 feet in depth.

#### CROSSINGS OF ROADS, &c.

The crossings consist of nine turnpike-roads, six to be passed over the railway and three under; thirty-one streets, highways, and parish-roads, fourteen over and seventeen under, including Trafalgar-place, Frederic-place, Gloucester-lane, Frederic-street, North-lane, and Church-street, Brighton; forty-six occupation-roads, seventeen over and twenty-nine under; twenty-nine brooks, streams, &c. The Merstham Tramway to be passed six times over the railway, at elevations varying from 54 to 70 feet. The South-eastern Railway seventeen feet under, the Croydon Canal under, the Reigate Turnpike-road to be twice diverted.

The railway to pass six times over the River Mole, and once over the Ouse, at a depth below the rails' top surface of 84 feet.

In the Shoreham branch the crossings consist of six highways and parish-roads, three to be passed over and three under; four occupation-roads, one over and three under; and four foot-paths.

In the Lewes branch there are seven high-ways and parish-roads, two to be passed over and five under; four occupation-



roads, one over and three under ; four foot-paths, and one level crossing.

The crossings of the Reigate branch are one turnpike-road over ; seven high-ways and parish-roads, two over and five under ; four occupation-roads over, and one stream.

#### REMARKS.

The whole length of the main line, from Croydon to Brighton, is 41 miles 59 chains, and is arranged in one level plane, 2 miles in length, and eight other planes, whose gradients vary from 1 in 264, or 20 feet in a mile, to 1 in 545, or 9.68 feet per mile. The characteristic gradient is 20 feet, there being six planes of this inclination, whose collective length is upwards of  $33\frac{1}{4}$  miles.

The whole length of the main line and branches is 72 miles 50 chains ; the prevailing gradient of the branches is also 20 feet per mile.

In the Lewes branch there is one plane descending to that town, at the rate of 1 in 50 ; the length is  $55\frac{1}{2}$  chains, and it will require a stationary engine.

There are two tunnels in the main line, amounting together in length to  $\frac{3}{4}$  of a mile. In the Lewes branch the length of the two tunnels together is 1025 yards ; and in the Newhaven branch, there is one tunnel of 120 yards in length.

The Clayton Hill tunnel in the main line is at the greatest depth from the surface of ground, being 168, and that at Lewes, the least, being 36 feet. The whole length of tunnelling is 1 mile 3 furlongs and 45 yards.

The curves under  $\frac{3}{4}$  of a mile' radius are five in number, but are confined to the branches.

The principal earthworks in the main line are the embankment at Vale Bridge-road, which is 1 mile 14 chains in length, and averages 30 feet in height ; that of the River Ouse, 1 mile and 4 chains in length, and averaging 32 feet in height ; the Merstham cutting, 3 miles 38 chains in length, and averag-



ing 60 feet in depth ; and that at the south-end of Clayton Hill Tunnel, 2 miles 15 chains long, and averaging 52 feet in depth.

The bridges for roads, &c. are one hundred and nine, and the bridges and culverts for brooks and streams, twenty-nine in number.

The clear height allowed for turnpike-road arches over the railway is 13 feet 6 inches, and for those under the railway, 17 feet.

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## LONDON AND BRIGHTON RAILWAY.

IN CONTINUATION OF THE CROYDON RAILWAY.

JOSEPH GIBBS, Esq., Engineer.

This line commences near the Town Hall, Brighton, and crosses Mill-street, Ship-street, Middle-street, and Duke-street, and passes by a tunnel under West-street, Sawyer's timber-yard, and road near the temple ; thence curving through Haughton parish, and by a long tunnel passing through Edburton parish, to the left of Corner House, in Shormenbury parish ; thence in a direct line through Cowfield, West Grinstead, and Nuthurst parishes, to Broadwater, and passing to the right of Coldstaple Farm ; thence under the high ground by a tunnel, 5 chains to the right of Chedworth, and crossing Horsham Town ; thence continuing to Spooner's Wood and Parson's Farm, crossing Cow-lane, and passing 10 chains to the right of Durrant's Copse ; thence to the left of Bew Bush Pond, touching Pondsides Farm buildings, and passing to the right of Hall's Farm, 8 chains to the left of Sadler's-green ; thence to the right of Ifield Church, across Ifield Green, 5 chains to the right of Pickett's Green ; thence through Bennett's Copse, across West-field Common, 3 chains to the left of Charlwood Park, 15 chains to the right of Brick House, across Hookwood



Common, 7 chains to the left of May Green Farm; thence to Halser Lane Farm, 6 chains to the left of Pettridge Wood Farm, across Pettridge Wood and Earl's Commons, 6 chains to the left of Hooley Park, 6 chains to the left of Great Wiggy Farm, 3 chains to the right of Little Wiggy Farm, 10 chains to the left of Aulbury Farm, 12 chains to the right of Mers-  
tham, 2 chains to the left of the Joliffe Arms Inn; thence by a tunnel under the high ground, the Merstham tramway being on the left; thence crossing this tramway at several different points, and passing through Coulsdon, close on the right of the Red Lion Inn, and passing through Beddington; thence continuing to Croydon, crossing Sanderstead-road, Selsdon-lane, Croham-lane, Addiscombe-road, and the Croydon Canal, and proceeding by two branches to its junction with the Croydon Railway, near that town.

The Vauxhall branch passes through Croydon and Streatham parishes, and crosses Atkins's-road, Poynder's-road, Park-hill, Park-road; and thence, by means of a viaduct, about half a mile in length, passing over the Clapham Turnpike-road, Union-road, James-street, Priory-road, Back-lane, and Miles-street, terminates near the toll-house, at the junction of the Vauxhall and Wandsworth-roads.

## GRADIENTS, &amp;c.

| Distance from Brighton. |         | Length of each plane. |      | Gradient. | Inclination. | Ascending or Descending. | Locations.                     |
|-------------------------|---------|-----------------------|------|-----------|--------------|--------------------------|--------------------------------|
| Miles                   | Chains. | Ms.                   | Chs. | Feet.     |              |                          |                                |
|                         | 20      |                       | 20   |           |              | Level                    |                                |
| 1                       | 0       |                       | 60   | 120       | 1 in 44      | Ascending                | Road past Wick-House.          |
| 1                       | 60      |                       | 60   |           |              | Level.                   |                                |
| 3                       | 52½     | 1                     | 72½  | 13·64     | 1 in 387     | Ascending.               |                                |
| 4                       | 56      | 1                     | 3½   |           |              | Level.                   | Entrance to long Tunnel.       |
| 11                      | 4½      | 6                     | 28½  | 15·90     | 1 in 332     | Descending               | Near river Adur.               |
| 23                      | 68½     | 12                    | 64   | 16·04     | 1 in 329     | Ascending.               |                                |
| 28                      | 0       | 4                     | 11½  | 15·95     | 1 in 331     | Descending               | White's Green.                 |
| 29                      | 36½     | 1                     | 36½  | 2·74      | 1 in 1922    | Descending               |                                |
| 36                      | 11      | 6                     | 54½  | 16·04     | 1 in 329     | Ascending.               |                                |
| 37                      | 11¼     | 1                     | 0¼   |           |              | Level.                   |                                |
| 45                      | 10½     | 7                     | 79¼  | 16·04     | 1 in 329     | Descending               | Junction with Croydon Railway. |



### GRADIENTS, &c., OF BRANCH TO VAUXHALL, AND DEVIATION TO SHOREHAM.

The proposed Vauxhall branch is  $8\frac{1}{2}$  miles in length, and consists of one level plane,  $17\frac{1}{2}$  chains long, and two other planes descending towards Vauxhall; the first at the rate of 1 in 320, and the second, which is the terminal plane, at the rate of 1 in 318.

The possible deviation to Shoreham is 14 miles  $47\frac{3}{4}$  chains in length, and has one level plane  $6\frac{1}{2}$  miles long; and two planes, ascending towards Shoreham, at the rate of 1 in 1239 and 1 in 427.

### TUNNELS—MAIN LINE.

| Nos. | Length. |                 | Height. Below Surface. |       | Inclination.    | Locations.                          |
|------|---------|-----------------|------------------------|-------|-----------------|-------------------------------------|
|      | Miles.  | Chains.         | Feet.                  | Feet. |                 |                                     |
| 1    | 0       | 49              | 30                     | 150   | Level & 1 in 44 | Brighton.                           |
| 2    | 1       | 30              | 30                     | 372   | 1 in 330        | At Road from the Dyke to Portslade. |
| 3    | 0       | $41\frac{3}{4}$ | 30                     | 100   | 1 in 330        | Road to Coldstaple.                 |
| 4    | 0       | $61\frac{1}{2}$ | 30                     | 170   | 1 in 329        | At Road to Wood-place.              |

### PRINCIPAL EARTHWORKS.—MAIN LINE.

| Description. | Length. |      | Greatest height or depth. | Average height or depth. | Locations.                         |
|--------------|---------|------|---------------------------|--------------------------|------------------------------------|
|              | Ms.     | Chs. | Feet.                     | Feet.                    |                                    |
| Cutting      | 0       | 64   | 52                        | 32                       | Road to Houghton, at three miles.  |
| Cutting      | 1       | 3    | 123                       | 52                       | By long tunnel.                    |
| Cutting      |         | 68   | 116                       | 54                       | At Road from Poynings to Folking.  |
| Embankment   | 1       | 60   | 38                        | 20                       | Between 7 and 9 miles.             |
| Embankment   | 1       | 52   | 41                        | 28                       | River Adur.                        |
| Embankment   | 1       | 7    | 40                        | 32                       | Road to Maplehurst Common.         |
| Cutting      | 1       | 0    | 90                        | 48                       | At 17 miles, by Coldstaple tunnel. |
| Embankment   | 1       | 12   | 41                        | 18                       | River Arun.                        |
| Cutting      | 2       | 0    | 50                        | 36                       | Spooner's Wood.                    |



| Description.     | Length. |      | Greatest height<br>or depth. |     | Average height<br>or depth. |    | Locations.                                                             |
|------------------|---------|------|------------------------------|-----|-----------------------------|----|------------------------------------------------------------------------|
|                  | Ms.     | Chs. | Feet.                        |     | Feet.                       |    |                                                                        |
| Cutting . . . .  | 1       | 60   | . . . .                      | 36  | . . . . .                   | 24 | . . . Durant's-lane, 23 miles.                                         |
| Embankment       | 2       | 40   | . . . .                      | 33  | . . . . .                   | 15 | . . . River Mole.                                                      |
| Cutting. . . .   | 2       | 30   | . . . .                      | 91  | . . . . .                   | 48 | . . Merstham Mill Stream.                                              |
| Cutting. . . . . | 2       | 50   | . . . .                      | 141 | . . . . .                   | 86 | . . . Between 37 and 40 miles,<br>by tunnel at road to Wood-<br>place. |
| Embankment       | 1       | 20   | . . . .                      | 24  | . . . . .                   | 14 | . . . Sanderstead-road.                                                |
| Cutting. . . . . | 1       | 40   | . . . .                      | 59  | . . . . .                   | 26 | . . . Croydon.                                                         |

## CROSSINGS OF ROADS, &amp;c.

The turnpike-roads are sixteen in number, nine to be passed over the railway and seven under; sixty-nine highways, forty-five over and twenty-four under; thirty occupation roads, fourteen over and sixteen under: seven foot paths; sixteen brooks, streams, &c; the Croydon Canal over. The Croydon Tramway to be passed ten times over the railway, and once under; the River Mole, eight times; the River Adur, at 41 feet; and the River Arun, at 44 feet below the rails' top surface.

In the Shoreham deviation, twenty-six highways and parish roads to be crossed, eighteen to be passed over and eight under the railway; nine occupation roads, four over and five under; two footpaths, one stream, and one crossing of the River Adur.

The crossings of the Vauxhall branch are—one turnpike road under; fourteen highways and parish roads over; two occupation roads, one over and the other under.

The Croydon Canal to be passed on the level.

## REMARKS.

The whole length of this line, from the Croydon Railway to the intended terminus at Brighton, is 45 miles  $10\frac{1}{2}$  chains, and consists of three level planes, amounting in length to 3 miles  $3\frac{3}{4}$  chains; and 12 inclined planes, four ascending from Brighton, and having gradients varying from 120 feet in a



mile, or 1 in 44, to 13·64 feet per mile, or 1 in 387 ; and three descending in the same direction, inclining at the rate of from 1 in 329, or 16·04 feet per mile, to 1 in 1922, or 2·74 feet in a mile.

The plane of 1 in 44 is that contiguous to the Brighton terminal plane, is three-quarters of a mile in length, and will require a stationary engine.

The Vauxhall branch, having tolerably good gradients, is  $8\frac{1}{2}$  miles in length, making the total distance from Brighton to Vauxhall 53 miles  $50\frac{1}{2}$  chains.

A practical deviation is shewn in the plans and sections to Shoreham, 14 miles  $47\frac{3}{4}$  chains in length—the gradients of which are very favourable.

The whole length of tunnelling in the main line is 3 miles  $22\frac{1}{4}$  chains.

That at the road from the Dyke to Portslade is 372 feet below the surface—the depths of the others vary from 100 to 170 feet.

The River Adur embankment is 1 mile 52 chains long, and averages 28 feet in height ; that at the road to Maplehurst Common, in length 1 mile and 7 chains, averages 32 feet in height. The chief cutting is 2 miles 5 furlongs in length, and averages 86 feet in depth ; it is about 5 miles from Croydon ; and the Merstham cutting is 2 miles 3 furlongs in length, and averaging 48 feet in depth.

The bridges required for roads &c. are one hundred and forty-four, and for brooks, streams, &c. including culverts, sixteen in number.

The clear height allowed for turnpike-road arches over the railway, is 16, and for those under, 18 feet. These dimensions are calculated to meet almost every contingency.

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## LONDON AND BRIGHTON RAILWAY.

G. and R. STEPHENSON, ESQRS., Consulting Engineers.

G. P. BIDDER, ESQ., Acting Engineer.

This line commences by a junction with the London and Southampton Railway, in the parish of Wimbledon, 23 chains to the north of the road from Wimbledon to Merton; thence through Merton parish, and to the right of Morden Park, intersecting the village of Lower Morden, a quarter of a mile to the right of Pylford Bridge, 4 chains to the left of Sparrow Farm-buildings, 10 chains to the right of Epsom Court, passing Epsom Common by means of a tunnel; thence nearly dividing Ashstead Woodfield into equal portions, across north-east corner of Barnet Wood, 11 chains to the left of Leatherhead Church, crossing the River Mole, in Leatherhead parish; thence through Norbury Park, and again crossing the Mole, 3 chains to the left of the Punch Bowl public-house, in Dorking parish, passing the high ground just beyond by means of a second tunnel, 6 chains to the left of Scammel's Farm; thence across Rout Hill Copse; thence curving through Newdigate and Capel parishes, 6 chains to the left of Warnham, 15 chains to the right of Warnham Court, crossing the Horsham and Worthing road, 13 chains to the left of the Cock public-house, 5 chains to the left of Cob's Hill House, in Nuthurst parish; thence through Freeman's Wood, and across Joel's Field Common, in West Grinstead parish; thence in a direct course to Henfield parish, curving slightly, and re-curving to and crossing Beeding-street, nearing the River Adur, within one chain to the left; thence crossing Beeding Chalk-pit; thence passing Old Shoreham, 16 chains to the left of the Church, and skirting New Shoreham parish; thence curving close to Egypt,  $6\frac{1}{2}$  chains to the right of Kingston Church, 5 chains to the left of Alexandria, close to the village of Southwick, 26 chains to the left of Copperas Gap, in Portslade parish;



thence into Hove parish, and entering Brighton by two branches; the northern by means of a tunnel or archway and curving across Cheapside, Trafalgar-street, Gloucester-lane, and terminating on the north side of North-lane, 6 chains from the meeting of Frederick-street.

The western branch leaves the Antheum 17 chains to the right; thence passing Wick House on the left, crossing Chalybeate-street, Temple-street, and Montpelier-street, terminates in a plot of ground behind the houses on the west side of Hampton-place, and  $4\frac{1}{4}$  chains from the western road.

## GRADIENTS, &amp;c.

Datum—100 feet below the level of Trinity High Water, London.

| Distance from junction with London and Southampton Railway. |                 | Length of each plane. |                 | Gradient. | Inclination. | Ascending or Descending. | Locations.                                 |
|-------------------------------------------------------------|-----------------|-----------------------|-----------------|-----------|--------------|--------------------------|--------------------------------------------|
| Miles.                                                      | Chains.         | Ms.                   | Chs.            | Feet.     |              |                          |                                            |
| 0                                                           | 70              | 0                     | 70              |           |              | Level                    |                                            |
| 4                                                           | 0               | 3                     | 10              | 16·       | 1 in 330     | Ascending                |                                            |
| 4                                                           | $79\frac{1}{4}$ | 0                     | $79\frac{1}{4}$ | 11·63     | 1 in 454     | Ascending                | Near turnpike-road Kingston to Ewell.      |
| 8                                                           | $0\frac{3}{4}$  | 3                     | $1\frac{1}{2}$  | 15·90     | 1 in 332     | Ascending                | Tunnel in this plane.                      |
| 9                                                           | $61\frac{3}{4}$ | 1                     | 61              |           |              | Level                    |                                            |
| 11                                                          | 74              | 2                     | $12\frac{1}{4}$ | 13·13     | 1 in 402     | Descending               | Near River Mole.                           |
| 12                                                          | $54\frac{1}{2}$ | 0                     | $60\frac{1}{2}$ | 7·93      | 1 in 665     | Ascending                |                                            |
| 19                                                          | 15              | 6                     | $40\frac{1}{2}$ | ·61       | 1 in 8588    | Ascending                | Near public road from Newdigate to Rusper. |
| 21                                                          | $22\frac{1}{2}$ | 2                     | $7\frac{1}{2}$  |           |              | Level                    | Summit plane.                              |
| 28                                                          | $18\frac{1}{2}$ | 6                     | 76              | 16·       | 1 in 330     | Descending               |                                            |
| 29                                                          | 33              | 1                     | $14\frac{1}{2}$ | 4·02      | 1 in 1313    | Ascending                | Occupation-road to Tower-hill.             |
| 36                                                          | 0               | 6                     | 50              | 16·       | 1 in 330     | Descending               |                                            |
| 38                                                          | $63\frac{3}{4}$ | 2                     | $63\frac{3}{4}$ | 7·86      | 1 in 671     | Descending               |                                            |
| 45                                                          | $21\frac{1}{2}$ | 6                     | $37\frac{3}{4}$ |           |              | Level                    |                                            |
| 50                                                          | 0               | 4                     | $58\frac{1}{2}$ | 13·23     | 1 in 399     | Ascending                | Western Terminus, Hampton-place, Brighton. |

The branch to the Brighton Northern Terminus is 1 mile 62 chains in length, and contains one ascending plane, 1 mile  $17\frac{1}{2}$  chains long, the gradient of which is 16 feet per mile, and the remainder is level.



## TUNNELS IN MAIN LINE.

| Length.<br>Yards. | Height.<br>Feet. | Below surface.<br>Feet. | Inclinations.  | Locations. |
|-------------------|------------------|-------------------------|----------------|------------|
| 500 .....         | 22 .....         | 80 .....                | 1 in 330 ..... | Epsom.     |
| 572 .....         | 22 .....         | 152 .....               | 1 in 330 ..... | Dorking.   |

## NORTHERN BRANCH AT BRIGHTON.

|           |          |          |                |           |
|-----------|----------|----------|----------------|-----------|
| 220 ..... | 22 ..... | 50 ..... | 1 in 330 ..... | Brighton. |
|-----------|----------|----------|----------------|-----------|

## EARTHWORKS.

| Description. | Length. |      | Greatest height<br>or depth.<br>Feet. | Average height<br>or depth.<br>Feet. | Locations.                 |
|--------------|---------|------|---------------------------------------|--------------------------------------|----------------------------|
|              | Ms.     | Chs. |                                       |                                      |                            |
| Embankment   | 1       | 27   | 28                                    | 17                                   | Merton.                    |
| Cutting      | 0       | 57   | 42                                    | 28                                   | Cuddington.                |
| Embankment   | 1       | 40   | 45                                    | 24                                   | Ewell.                     |
| Cutting      | 0       | 65   | 63                                    | 25                                   | Epsom.                     |
| Cutting      | 0       | 73   | 47                                    | 28                                   | Leatherhead.               |
| Embankment   | 0       | 76   | 35                                    | 25                                   | Leatherhead.               |
| Cutting      | 0       | 19   | 86                                    | 48                                   | Mickleham.                 |
| Cutting      | 1       | 9    | 57                                    | 34                                   | Capel.                     |
| Embankment   | 0       | 71   | 38                                    | 18                                   | Warnham.                   |
| Embankment   | 1       | 6    | 44                                    | 26                                   | Horsham.                   |
| Cutting      | 1       | 50   | 38                                    | 32                                   | Horsham.                   |
| Cutting      | 0       | 41   | 98                                    | 44                                   | Beeding.                   |
| Cutting      | 0       | 40   | 28                                    | 17                                   | Brighton Western Terminus. |

## NORTHERN BRANCH AT BRIGHTON.

|         |   |    |    |    |           |
|---------|---|----|----|----|-----------|
| Cutting | 0 | 40 | 82 | 46 | Hove.     |
| Cutting | 0 | 26 | 84 | 50 | Brighton. |

## CROSSINGS OF ROADS, &amp;c.

The crossings consist of eleven turnpike-roads, seven over and four under ; thirty-seven highways and parish-roads, sixteen over and twenty-one under ; seventy-eight occupation-roads, thirty-eight over and forty under ; nine foot-paths ; thirty-six brooks, streams, &c., and six level crossings. Henfield Cut to be passed over by the railway, and the River Mole at three several places.

The road from Steyning to be diverted for 26 chains, and the road from Steyning to Shoreham for 32 chains.



## REMARKS.

The whole length of this line, from its junction with the London and Southampton Railway to the Brighton Western Terminus, is 50 miles ; of this, the collective length of level planes, which are four in number, is 11 miles  $16\frac{1}{4}$  chains.

The gradients of the other planes range from 16 feet to 61 foot per mile ; the steepest plane, therefore, is at the rate of 1 in 330, or 16 feet per mile, the gradient chiefly prevailing on the London and Birmingham Railway.

The summit plane is 21 miles  $22\frac{1}{2}$  chains from the Southampton Railway, and 191 feet 3 inches above the level of its rails' top surface at point of junction. The descent from the summit to the Western Terminus at Brighton is 171 feet 9 inches.

The length of the Northern Branch to Brighton is 1 mile 62 chains, and consists of two planes, the first ascending from the main line at the rate of 16 feet per mile, or 1 in 330, for a length of 1 mile  $17\frac{1}{2}$  chains ; and the terminal plane, at the intended northern station, is level.

The whole length of tunnelling in the main line is 4 furlongs and 192 yards. In the Northern Branch there is a tunnel one furlong in length.

The tunnel, at the greatest depth below the surface of ground, is that at Epsom, being 152 feet.

The heaviest embankment is at Ewell,  $1\frac{1}{2}$  miles in length, and averaging 24 feet in height ; and the chief cutting at Horsham, 1 mile 50 chains long, and averaging 32 feet in depth.

The number of bridges required for roads, &c., is one hundred and thirty-nine, and of culverts and bridges for streams, brooks, &c., thirty-six, and there are six level crossings. The clear height allowed for turnpike-road arches over the railway is 15, and for those under, 16 feet.

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**EXETER AND FALMOUTH RAILWAY.**

(Called the London, Exeter, and Falmouth Railway.)

GEORGE LANDMANN, WILLIAM TIERNEY CLARK, ESQRS., Engineers.

This line commences about 9 chains to the left of Kimberly-terrace, and 16 chains to the left of Brook-street, in the parish of Falmouth; it then crosses Killigrew-street, and the road to Budock Church, and curving through the parish of Gluvias, passes within 4 chains of Parnongow, on the left; thence crossing the road from Penryn to Helstone, and passing by means of a tunnel under the road from Helstone to Truro; thence crossing the road to Redruth, about 8 chains to the right of Burnt House, through Carsawes Wood, and curving round towards Terran Well, which it passes 8 chains to the left, and recurving across Greenwith Downs, into Carran Valley; thence crossing the Deveron Railway, and passing to the Consols Mines; thence continuing to the right of Higher Town, and curving through Bosvigo Wood, 10 chains to the left of Bosvigo, recurving to Compregny, about 7 chains to the right, through the parish of St. Clement, intersecting Bishop's Wood, and crossing the road from St. Allen, 4 chains to the right of Reskief, 6 chains to the right of Tolcarne; thence crossing St. Allen's River, and passing through the parish of St. Erme, 3 chains to the left of Killigrew, 3 chains to the left of Hendra, 10 chains to the left of Great Landrine; thence 2 chains to the right of Rosparva, across the road from Rosewin to Summer-court, passing 3 chains to the left of Gunrowson, crossing the road from Nanpean to Summercourt; thence 4 chains to the left of Penhale, 5 chains to the right of Habreana Farm, through the parish of St. Columb Major, over Tregoss Moor,



passing by Holywell on the right, 6 chains to the right of Reperry Mill, within 2 chains to the left of Tretoil, curving across the road from Lostwithiel to Bodmin, and within 6 chains to the right of Higher Halgraner, 5 chains to the left of Carminha Cross ; thence across the road to St. Neot's, in the borough of Bodmin, 8 chains to the right of Lemar, within 2 chains to the left of Magor's, over Cardinham Common, within 8 chains and to the left of Lower Corblake, within 3 chains to the right of Poundsconce, 6 chains to the right of Wall-house, over Temple Moor, crossing the Temple River ; thence into the parish of Alternon, passing near the ancient Circle of Stones ; thence to the right of Lower Tregunner, 8 chains to the right of Trewin Church, through the parish of St. Thomas, crossing the River Attery, and passing within half a mile of Launceston ; thence to the left of Colhay, crossing the River Tamar, within 5 chains to the right of Nethercot, 5 chains to the left of Coombe, and passing to the right of Downacarey and Anglo, within 5 chains and to the right of Tower Hill, through the parishes of Ashwater and Broadwood Widger, through the parish of Beaworthy, within 3 chains of Luckcroft on the left, 6 chains to the right of Norleigh, 6 chains to the right of Milltown, within 6 chains and to the right of Norley Mill, crossing Inwardleigh Moor, 9 chains to the right of Croft, through the parish of Sampford Courtenay, crossing Sampford Moor, 3 chains to the right of Southey, 6 chains to the right of Treecot, 7 chains to the left of Fullaford, 10 chains to the right of Greenslade, crossing Halse Moor, Itton Moor, Broad Nymet Moor, Natson Moor, and Longford Moor ; thence through the parish of Clannaborough and Colebrook, running within 5 chains and on the left of the River Yeo, within 2 chains and to the left of Folly, 5 chains to the left of Yeoton Village, 5 chains to the left of Yeoton Barton, 6 chains to the right of Fordton House, and 10 chains to the right of the River Yeo, at Fordton Bridge, 3 chains to the right of Kesford, passing through Downes Wood, and near-



ing the River Yeo, within 1 chain on the right, 6 chains to the left of Dunscombe, across the River Creedy; thence to Sweatham, close on the right of Winscot, through Oakford; thence to the left of the River Creedy, and within 3 chains thereof, and recurving to its junction with the Bristol and Exeter Railway,  $14\frac{1}{2}$  chains north-east of Cowley Bridge.

#### BRANCH TO REDRUTH.

This branch commences at Castle Hill, in the parish of St. Mary, proceeds within 3 chains to the right of Hendra, 7 chains to the right of St. Coose, curving and recurving through the parish of Kenwyn, and passing within 3 chains to the right of Lanegarth; thence across the roads from St. Agnes to Truro, and from Bissoe Bridge to Perran, through the parish of Kea; thence through the parish of Gwennap, and crossing the road from Redruth to Truro, within 2 chains of Scorrier Gate on the left; thence passing to Wheal Harmony Mine, in the parish of Redruth.

#### CURVES.

The curves in the main line under  $\frac{3}{4}$  of a mile' radius, are sixteen in number, of which, nine are of  $\frac{1}{2}$  a mile, four of a quarter of a mile, one of 21 chains, one of 16 chains, and, lastly, one of 43 chains' radius. In the Redruth branch, the worst curves are, one of 30 chains, and one of  $\frac{3}{4}$  of a mile' radius.

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## GRADIENTS, &amp;c.

Datum—59 feet below the level of High Water on the South Coast of  
Cornwall.

| Distance from<br>Terminus at<br>Falmouth. |                  | Length of<br>each plane. |                  | Gra-<br>dient. | Inclina-<br>tion. | Ascending or<br>Descending. | Locations.                                                    |
|-------------------------------------------|------------------|--------------------------|------------------|----------------|-------------------|-----------------------------|---------------------------------------------------------------|
| Miles.                                    | Chains.          | Ms.                      | Chs.             | Feet.          |                   |                             |                                                               |
|                                           | 13 $\frac{1}{4}$ |                          | 13 $\frac{1}{4}$ |                |                   | Level                       |                                                               |
| 1                                         | 69 $\frac{1}{2}$ | 1                        | 56 $\frac{1}{4}$ | 28.23          | 1 in 187          | Ascending                   |                                                               |
| 3                                         | 43               | 1                        | 53 $\frac{1}{2}$ | 12.            | 1 in 440          | Descending.                 |                                                               |
| 4                                         | 50               | 1                        | 7                | 46.31          | 1 in 114          | Descending                  |                                                               |
| 6                                         | 48               | 1                        | 78               | 6.07           | 1 in 869          | Descending                  |                                                               |
| 7                                         | 48 $\frac{1}{2}$ | 1                        | 0 $\frac{1}{2}$  | 49.81          | 1 in 106          | Ascending                   |                                                               |
| 8                                         | 44               |                          | 75 $\frac{1}{2}$ |                |                   | Level.                      |                                                               |
| 9                                         | 23 $\frac{1}{4}$ |                          | 59 $\frac{1}{4}$ | 50.28          | 1 in 105          | Descending                  |                                                               |
| 11                                        | 63               | 2                        | 39 $\frac{3}{4}$ |                |                   | Level                       | Near road to Pen-<br>mount.                                   |
| 13                                        | 63 $\frac{1}{2}$ | 2                        | 0 $\frac{1}{2}$  | 50.28          | 1 in 105          | Ascending                   |                                                               |
| 16                                        | 62               | 2                        | 78 $\frac{1}{2}$ | 22.18          | 1 in 238          | Ascending.                  |                                                               |
| 18                                        | 62               | 2                        | 0                | 12.51          | 1 in 422          | Ascending.                  |                                                               |
| 26                                        | 19               | 7                        | 37               | 21.72          | 1 in 243          | Ascending                   |                                                               |
| 27                                        |                  |                          | 61               |                |                   | Level                       | Holywell.                                                     |
| 32                                        | 77               | 5                        | 77               | 16.14          | 1 in 327          | Descending                  |                                                               |
| 33                                        | 17               |                          | 20               |                |                   | Level                       |                                                               |
| 41                                        | 73               | 8                        | 56               | 50.76          | 1 in 104          | Ascending                   |                                                               |
| 43                                        | 13               | 1                        | 20               |                |                   | Level                       |                                                               |
| 45                                        | 69 $\frac{1}{2}$ | 2                        | 56 $\frac{1}{2}$ | 20.78          | 1 in 254          | Descending                  |                                                               |
| 56                                        | 29               | 10                       | 39 $\frac{1}{2}$ | 51.26          | 1 in 103          | Descending                  | River Tamar.                                                  |
| 56                                        | 78               |                          | 49               |                |                   | Level                       |                                                               |
| 67                                        | 64               | 10                       | 66               | 20.38          | 1 in 259          | Ascending                   |                                                               |
| 68                                        | 33 $\frac{1}{2}$ |                          | 49 $\frac{1}{2}$ |                |                   | Level                       | Road from Oke-<br>hampton.                                    |
| 73                                        | 54 $\frac{1}{2}$ | 5                        | 21               | 20.            | 1 in 264          | Descending                  |                                                               |
| 73                                        | 75               |                          | 20 $\frac{1}{2}$ |                |                   | Level.                      |                                                               |
| 76                                        | 35               | 2                        | 40               | 16.44          | 1 in 321          | Ascending                   |                                                               |
| 78                                        | 15               | 1                        | 60               |                |                   | Level                       | Near River Oxment.                                            |
| 79                                        | 74               | 1                        | 59               | 25.38          | 1 in 208          | Ascending                   |                                                               |
| 80                                        | 49 $\frac{1}{2}$ |                          | 55 $\frac{1}{2}$ |                |                   | Level                       |                                                               |
| 82                                        | 69               | 2                        | 19 $\frac{1}{2}$ | 8.02           | 1 in 658          | Descending                  |                                                               |
| 87                                        | 58               | 4                        | 69               | 14.83          | 1 in 356          | Descending                  |                                                               |
| 91                                        | 27               | 3                        | 49               | 50.28          | 1 in 105          | Descending                  |                                                               |
| 97                                        | 36               | 6                        | 9                | 20.15          | 1 in 262          | Descending                  |                                                               |
| 98                                        | 20               |                          | 64               |                |                   | Level                       |                                                               |
| 98                                        | 59               |                          | 39               | 22.56          | 1 in 234          | Ascending                   | Terminus, Level of<br>rails, Bristol and Ex-<br>eter Railway. |



The whole length of the branch to Redruth is 8 miles  $23\frac{1}{2}$  chains, and consists of twelve planes, ranging in inclination from 1 in 42 to 1 in 901. The worst planes are, 1 in 42 for  $46\frac{3}{4}$  chains; 1 in 51 for 68 chains; 1 in 57 for  $79\frac{3}{4}$  chains; 1 in 62 for 18 chains; and, 1 in 96 for  $32\frac{3}{4}$  chains in length.

## TUNNELS IN MAIN LINE.

| Nos. | Length.<br>Chains. | Height.<br>Feet. | Under Surface.<br>Feet. | Inclination.          | Locations.                                |
|------|--------------------|------------------|-------------------------|-----------------------|-------------------------------------------|
| 1    | $13\frac{3}{4}$    | 30               | 75                      | 1 in 471              | Old Turnpike-road.<br>Penryn to Helstone. |
| 2    | $22\frac{3}{4}$    | 30               | 120                     | Do.                   | Turnpike-road,<br>Helstone to Truro       |
| 3    | 23                 | 30               | 135                     | Level.                | Road from Carden<br>to Guderne.           |
| 4    | $13\frac{3}{4}$    | 30               | 115                     | 1 in 190              | At 15 miles.                              |
| 5    | 18                 | 30               | 180                     | 1 in $422\frac{1}{2}$ | Road from Land-<br>dock to Mitchell       |
| 6    | 40                 | 30               | 180                     | 1 in 255              | 45 miles.                                 |
| 7    | 27                 | 27               | 100                     | Level.                | Road Okehampton<br>to Horlesworthy.       |
| 8    | 14                 | 30               | 80                      | 164                   | Near River Lewer.                         |

## PRINCIPAL EARTHWORKS.—MAIN LINE.

| Description.             | Length         |              | Greatest height<br>or depth. |       | Average height<br>or depth. |       | Locations.                              |                                           |
|--------------------------|----------------|--------------|------------------------------|-------|-----------------------------|-------|-----------------------------------------|-------------------------------------------|
|                          | Ms.            | Chs.         |                              | Feet. |                             | Feet. |                                         |                                           |
| Embankment               | 0              | 22           | ...                          | 120   | .....                       | 75    | River to Perran Wharf.                  |                                           |
| Embankment               | 0              | 66           | ...                          | 103   | .....                       | 50    | At 7 miles.                             |                                           |
| Cutting                  | ....           | 0            | 34                           | ...   | 130                         | ..... | 75                                      | Entrance to Tunnel - road<br>from Carnon. |
| Embankment               | 1              | 52           | ....                         | 88    | .....                       | 38    | Near road to Penmount.                  |                                           |
| Cutting.....             | 0              | 53           | ....                         | 93    | .....                       | 70    | Near the same.                          |                                           |
| Cutting.....             | 0              | 56           | ...                          | 103   | .....                       | 53    | Turnpike-road from Truro<br>to Mitchel. |                                           |
| Cutting.....             | 1              | 40           | ....                         | 83    | .....                       | 48    | Near Holywell.                          |                                           |
| Several }<br>Cuttings. } | from }<br>to } | 30 {<br>40 { | from 60 }<br>to 90 }         |       | from 35 }<br>to 70 }        |       | Between 35 and 39 miles.                |                                           |
| Cutting.....             | 2              | 40           | ....                         | 68    | .....                       | 33    | At 40 miles.                            |                                           |



| Description. | Length. |      | Greatest height<br>or depth. |     | Average height<br>or depth. |    | Locations.                                                   |
|--------------|---------|------|------------------------------|-----|-----------------------------|----|--------------------------------------------------------------|
|              | Ms.     | Chs. | Feet.                        |     | Feet.                       |    |                                                              |
| Cutting..... | 1       | 30   | ....                         | 88  | .....                       | 52 | ... At 43 Miles.                                             |
| Cutting..... | 1       | 60   | ...                          | 130 | .....                       | 58 | ... Near Atternum River.                                     |
| Cutting .... | 0       | 72   | ...                          | 100 | .....                       | 52 | ... Between 50 and 51 miles.                                 |
| Embankment   | 0       | 40   | ....                         | 90  | .... :                      | 78 | ... River Tamar.                                             |
| Cutting. ... | 2       | 30   | ....                         | 70  | .....                       | 33 | ... By Tunnel under Oke-<br>hampton and Horlsworthy<br>road. |
| Cutting..... | 0       | 90   | ....                         | 85  | .....                       | 48 | ... Near road from North Taw-<br>ton to Cocktree Moor.       |
| Cutting..... | 0       | 63   | ...                          | 104 | .....                       | 55 | ... Road from Holliston Cross<br>to Colebrook.               |

## CROSSINGS OF ROADS, &amp;c.

There is a viaduct proposed to carry the railway over the River Inney, 660 feet in length, and about 130 feet in height; and a second, to cross the River Attery, 1155 feet in length, and 140 feet in height.

The turnpike-roads to be crossed are twenty-two in number; fifteen to be passed over the railway and seven under; one hundred and forty high-ways and parish-roads, eighty-two over and fifty-eight under; two foot-paths; one railway; forty-seven brooks, streams, &c. There are thirty-one river crossings, including that of the Tamar, which is 92 feet 6 chains under the rails; the Taw, 51 feet 6 inches; and the Oxment, 90 feet; besides the Inney and Attery viaducts.

## REMARKS.

The whole length of the main line is 98 miles 59 chains, consisting of twelve level planes, amounting in length to 8 miles 68 chains; and twenty-three inclined planes, varying in inclination, from 1 in 103, or 51·26 feet per mile, to 1 in 869, or 6·07 feet in a mile: the worst locomotive planes are, one of 51·26 feet per mile, or 1 in 103, descending to the River Tamar, for a length of 10 miles 39½ chains; one of 50·76 feet per mile, or 1 in 104 for 8 miles 56 chains; three of 50·28



feet per mile, or 1 in 105, whose collective length is 6 miles  $28\frac{3}{4}$  chains ; one of 49·81 feet per mile, or 1 in 106 for 1 mile and  $\frac{1}{2}$  a chain ; and, lastly, one of 46·31 feet per mile, or 1 in 114 : there are consequently eight planes, amounting in length to nearly one third of the whole line, each of which will require an assistant engine.

In the Redruth branch there are four planes, inclining at the rate of from 1 in 42\* to 1 in 62 ; these are so mixed with the planes of less inclination, that it will be necessary to work the whole, either by the stationary system, or by horse-power.†

The curves in the main line, under  $\frac{3}{4}$  of a mile' radius, are sixteen in number.

There are two long and lofty viaducts proposed to cross the vallies of the Inney and Attery rivers.

The tunnels are eight in number, and amount in length to 2 miles  $11\frac{3}{4}$  chains. They vary in depth below the surface from 75 to 180 feet.

The earthworks most worthy of notice, are the embankment at 7 miles from Falmouth, 66 chains long, averaging 50 feet in height ; that near the road to Penmount, 1 mile 52 chains in length, and averaging 38 feet in height ; the Tamar embankment,  $\frac{1}{2}$  a mile in length, and averaging 78 feet in height ; the Holywell cutting, which is  $1\frac{1}{2}$  miles in length, and

\* "The Redruth Railway has a continued length of about a mile and a half  
"with an inclination of 1 in 35, rising to its passage over the side of Carn-  
"marth ; and the Tram-road from Portreath has an inclination of about 1 in 25,  
"immediately south of where it crosses the turnpike-road to Redruth."

"On the railway from Narabo to Redruth, five loads of timber are drawn by  
"three small, or two large horses, from the sea side to the western part of the  
"Consolidated Mines, which portion of the line varies in inclination from level  
"to 1 in 36 : the distance being 5 miles."

Notes to Report on proposed Truro and Perran Railway, by Francis Whishaw and Richard Thomas, Civil Engineers, Jan. 1831.

† Until the Bodmin and Wadebridge line was constructed, the whole of the Cornish Railways were worked by horses.



averaging 48 feet in depth ; that near the Atternum river,  $1\frac{3}{4}$  miles in length, and averaging 58 feet in depth ; a third between 50 and 51 miles, which is 72 chains in length, and averaging 52 feet in depth ; and, lastly, one near Okehampton and Horlsworthy-road, 2 miles and 3 furlongs in length, and averaging 33 feet in depth.

The number of bridges required for roads, &c., is two hundred and five, exclusive of the two viaducts ; and the bridges and culverts for brooks, streams, &c., are forty-seven in number.

The clear height allowed for turnpike-road arches over the railway is 14 feet, and for those under, 16 feet.

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## LONDON AND PENGE RAILWAY.

WILLIAM CUBITT, Esq. F.R.S. M.R.I.A. Civil Engineer.

The object of this line is to obtain a convenient approach to the metropolis for the South Eastern Railway. It commences in the Borough-road, near the Obelisk, and running on the east-side of the London-road, crosses Earl-street, Newington-causeway, Poplar-row, and the New Kent-road ; thence passing through Walworth, and crossing Lion-street, New-street, Gloucester-road, Brandon-street, Sarah Ann-street, George-street, Bedford-street, Nursery-row, Eltham-street, East-street, Pleasant-row, Sandford-row, Trafalgar-street, Clandon-street, Waterloo-street, Walworth-common, Albany-road, Neate-street, and the Grand Surrey Canal ; thence proceeding to High-street, Peckham, which it crosses near the Canal basin, and thence curving through Camberwell parish, and crossing the Croydon Canal, near the boundary of the counties of Kent and Surrey, continues nearly in a right line to Sydenham and Beckenham, and thence to its junction with the Croydon Railway, at Penge Common.



The whole length of this line is 7 miles 21·72 chains, and extends from the intended Metropolitan Terminus in St. George's-fields, to New-street, a distance of half-a-mile, on a level, from whence it rises to its junction with the Croydon line, at the rate of 21·03 feet in a mile, or 1 in 253.

The chief earth-works are, the Camberwell embankment, 1 mile 53 chains in length, and averaging 35 feet in height, and the cuttings at Lewisham and Sydenham, the former of which is 1 mile 5 furlongs in length, and averaging 16 feet in depth, and the latter,  $1\frac{1}{4}$  miles in length, and averaging 22 feet in depth.

The streets and roads as far as the Surrey Canal are proposed to be crossed by a viaduct, about a mile in length, and averaging about 30 feet in height—the minimum height above the roads' top surface is 22 feet, which will entirely preclude the necessity of altering the levels of any of the roads or streets.

Fifteen bridges will be required for roads, &c. exclusive of the viaduct.

The Croydon Canal is twice passed over the railway; and Peckham High-street is crossed over by the railway at an elevation of 47 feet.

This intended Railway follows nearly the course of the proposed London and South End-road, for which our services were engaged a few years since.

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## LONDON, ROCHESTER AND CHATHAM RAILWAY.

JOHN BRAITHWAITE, Esq. Engineer.

This line is proposed to join the intended Thames Haven Railway, near the road from North Ockendon to South Ockendon, in the county of Essex, and curving within 4 chains of Ockendon Hall on the left, passes 11 chains to the right of Ockendon Grange; thence through Stifford parish, 25 chains to the left of Gray's Thurrock Church, and nearly in a direct



line to the river Thames at Tilbury Fort. The communication between the counties of Essex and Kent is proposed to be effected by means of a Steam Ferry Boat. The railway to commence again near Waite's Hotel, Gravesend; thence touching the Thames and Medway Canal basin, passes within  $6\frac{1}{2}$  chains of Milton Church on the right;  $9\frac{1}{2}$  chains to the left of West Court Farm, 15 chains to the right of Queen's Farm, and crossing the north end of the Thames and Medway Tunnel, passes 6 chains to the left of Brick-house Farm; thence through Cliff and Frindsbury parishes, and curving within 30 chains of the Church on the right, terminates at the intended depôt on the north bank of the Medway. The only curve under three quarters of a mile' radius, is that leaving the Thames Haven Railway, which is of 34 chains.

#### GRADIENTS, &c.

The length of the Essex portion of this intended railway is 6 miles  $0\frac{1}{2}$  chain, and consists of four planes—the first 1 mile in length, and rising 1 in 754, or 7 feet in a mile; the second 1 mile  $57\frac{1}{4}$  chains in length, descending at the rate of 1 in 825, or 6.40 feet per mile; the third, 2 miles  $22\frac{3}{4}$  chains in length, and descending at the rate of 1 in 400, or 13.20 feet per mile; and the last level, for 1 mile  $0\frac{1}{2}$  chain.

The gradients of the Kent portion, commencing at Gravesend, are, first, 9.10 feet per mile, ascending for 2 miles 51 chains; the second, ascending for 2 miles 29 chains, at 15 feet; the third, descending also at the rate of 15 feet; and, lastly, the Rochester terminal plane, descending at 10 feet per mile.

#### EARTHWORKS.

The principal earthworks are—an embankment in the Essex portion, in Little Thurrock and Chadwell parishes,  $2\frac{1}{4}$  miles long, and averaging about 10 feet in height; and in the Kent portion, a cutting in Higham and Cliff parishes, 1 mile 72 chains long, and averaging 30 feet in depth.



## CROSSINGS OF ROADS, &amp;c.

The crossings of roads, &c., in the Essex portion of the line, consist of six roads to be passed over the railway; two occupation roads, one over and one under; and two drains under.

In the Kent portion, the crossings are twelve roads to be passed over the railway and one under; one occupation road over and one under; one occupation road to be diverted; and a footpath to be crossed on the level.

## REMARKS.

The whole length of the Essex portion of this line is  $6\frac{1}{2}$  miles  $0\frac{1}{2}$  chain, and is divided into one level plane, 1 mile and  $0\frac{1}{2}$  chain long, and three inclined planes, whose gradients are 7 feet 6.40, and 13.20 feet per mile.

The terminal plane joining the proposed Thames Haven Railway, is on an ascent from that line, and that next to the Thames at Tilbury Fort, level.

The whole length of the Kent portion is 7 miles 48 chains, and consists of four slightly inclined planes, whose gradients are severally 9 feet, 10 feet, and 15 feet per mile, and are therefore very favourable.

The earthworks are but slight, except the Higham cutting, and there is only one curve under three-quarters of a mile radius.

The bridges and culverts required for roads and drains, according to the Parliamentary section, are twenty-four in number.

An examination which we made last autumn of a line similar in its object to the present plan, led to the most favourable results with regard to crossing the Thames; but our idea, of proceeding on the Kent side, was to take nearly the line of the Thames and Medway Canal—avoiding its sinuosities, and proceeding on a level for the whole distance, and for nearly two miles in a straight course through the two tunnels.



## LONDON AND SOUTHAMPTON RAILWAY.

## PROPOSED DIVERSIONS.

JOSEPH LOCKE, Esq., Civil Engineer.

## DIVERSION No. 1.

This Diversion commences at the London Terminus, on the south bank of the Thames at Nine Elms, in the parish of Battersea, and extends on a level plane for a length of 8 chains, with a curve of about 9 chains' radius, to its junction with the Parliamentary line; intersecting in its course Nine Elms-lane, which is proposed to be raised 4 feet, and crossed on the level.

## DIVERSION No. 2.

The next Diversion commences in the parish of Walton-on-Thames, passes across part of Oatlands Park, crosses Walton Common and the River Wey, and terminates at its junction with the original line in the parish of Byfleet. The whole length of this diverted line is 3 miles 30 chains, and is divided into three planes; two of which rise at the rate of 1 in 319 and 1 in 310, or 16.55 and 17.03 feet per mile, and the remainder is level for  $58\frac{1}{4}$  chains. It is in cutting for 2 miles 17 chains, averaging 24 feet deep; and the River Wey embankment is 1 mile long, and averaging 24 feet high.

## DIVERSION No. 3.

This Diversion leaves the original line near Brookwood Stumps, in the parish of Woking, passes across Woking Common, continues to the left of the Basingstoke Canal, 3 chains to the left of Pirbright Lock House, crossing Pirbright Common, and passing 7 chains to the left of Trimley Lock



House, 4 chains to the left of Mr. Birnie's Farm House, crossing the Basingstoke Canal, and passing within 4 chains of Frimley Wharf on the left; thence crossing Blackwater Brook, joins the Parliamentary line in the parish of Farnborough.

The length of this diversion is 4 miles  $53\frac{1}{2}$  chains; of this, one plane is level for 1 mile 18 chains, and a second for 10 chains, and the gradients of the two other planes are 17.60 and 16.70 feet per mile. It is partly in cutting and partly in embankment. The cutting in Ash parish is the principal earthwork, and is 1 mile 63 chains long, and averaging 38 feet deep.

#### DIVERSION No. 4.

This Diversion leaves the main line in the parish of Wooten St. Lawrence, near East Oakley, and is proposed to be effected in order to avoid the Popham Tunnel.

It passes through Church Oakley Parish, and continues to Steventon; thence within 23 chains of South Litchfield on the left, and passing 34 chains to the right of Popham Beacons, 2 chains to the right of Warren Farm, 5 chains to the right of Sheep House Farm, continues to its junction with the original line at Tufton Way, in West Colley Tithing.

This divergence is 8 miles  $16\frac{1}{2}$  chains in length, and consists of one level plane, 4 miles  $35\frac{1}{2}$  chains long, and the remainder falling at the rate of 1 in 250, or 21.12 feet per mile. This diversion is in cutting and embankment; the chief earthwork is a cutting, in Overton and Mitcheldever, 1 mile 70 chains long, and averaging 47 feet deep.

#### DIVERSION No. 5.

This Diversion leaves the Parliamentary line in the parish of Saint Faith, otherwise Saint Cross, and passing Saint Cross on the left, proceeds to Shawford, and running on the right of the Itchen Navigation, joins the original line in the parish of



Otterbourne. It is 2 miles 50 chains long, and inclines at the rate of 1 in 250, or 21·12 feet per mile.

DIVERSION No. 6.

This Diversion commences at the road north of the Marsh, at the intended Southampton depôt, and terminates at the beach of the Southampton Water; it is  $8\frac{1}{2}$  chains long, and level.

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MANCHESTER AND BOLTON RAILWAY.

PROPOSED BRANCH TO THE MANCHESTER AND LIVERPOOL RAILWAY.

JESSE HARTLEY, and JOHN HARTLEY, Jun<sup>r</sup>., ESQ<sup>RS</sup>., Engineers.

The object of this branch is to connect the Manchester and Bolton with the Manchester and Liverpool Railway, and to afford to the latter a second convenient station in Manchester, the depôt of the former being on the west side of New Bailey-street, which is only 825 yards, or less than half a mile, from the Exchange, being 675 yards shorter than the Manchester and Liverpool station from the same building.

This line is intended to diverge from the Manchester and Bolton Railway, close to Hope Town Mill, and about a quarter of a mile from the Oldfield-road Canal Bridge, and proceeding by a curvilinear course, intersects Cross-street, at 17·75 chains distant from the Manchester and Liverpool Railway, at Cross-lane Bridge, and recurving to its junction with that way, at the boundary of the Townships of Salford and Pendleton.

The whole length of this branch is 1 mile 78·56 chains, and rises from the Manchester and Bolton Railway, with an inclination of 1 in 600, or 8·80 feet in a mile, for a length of 1 mile 74·56 chains, the remaining portion being level.



This line presents two curves, each of about 50 chains' radius. In its course it crosses eight roads, which are severally above the rails, and one brook, which is under. It is chiefly in cutting, which extends for about three quarters of a mile, and averages 9 feet in depth.

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## MANCHESTER, CHESHIRE AND STAFFORDSHIRE RAILWAY.

J. U. RASTRICK, Esq. Engineer.

This line commences at Store-street, Manchester,  $4\frac{3}{4}$  chains from the London-road, and crossing Ashton-street, Boad-street, Travis-street, Fairfield-street, the river Medlock, Union-street, Chancery-lane, and the Turnpike-road to Sheffield, passes 8 chains to the left of Longsight, 9 chains to the right of Midway House; thence to the right of Levenshulme, within 2 chains of the turnpike-road to Stockport, near which the Stockport deviation line diverges to the left.

The main line continues across Black Brook; thence to Shaw Fold, 10 chains to the right of Brinksway Bridge, across the river Mersey, 9 chains to the right of the bleach works in Cheadle Bulkeley Township; thence within 4 chains of Adswold Mill, 7 chains to the left of the Church, on the road from Cheadle to Dean-row, across the rivers Dean and Bollin, 22 chains to the left of Wilmslow Church, 10 chains to the left of Whitehall Farm; thence continuing to Chorley, and passing 5 chains to the left of Gatley Green, in Alderley parish, near which the first divergence to the Grand Junction Railway at Crewe commences; thence to the right of Sandle House, 2 chains to the left of Fallows Hall, passing to Davenport Farm, in Marton Township, within one chain and to the left of Mill Bank, 9 chains to the right of Marton Mill, 12 chains to the left of Hulme-Walfield Hall; thence curving to Congleton, across Moreton Meadows Farm, 8 chains to the right of Lower Hulme Farm; thence close to Oak Farm Buildings, and keeping close to the right of the Mac-



clesfield Canal, passes 4 chains to the left of Kent Green Farm ; thence crossing the same canal in Church Lawton Township, and curving within 7 chains of Floodgates on the right,  $2\frac{1}{2}$  chains to the right of Wolstanton Church ; thence, with a tunnel under the high ground, skirting Bath Pool, and crossing the Grand Trunk Canal a quarter of a mile from its tunnel's mouth, in Tunstall parish, passing about 6 chains to the left of the Grand Trunk Canal, within 5 chains and to the right of Burslem Church, 13 chains to the right of Rushton Grange ; thence within 4 chains to the right of the race-course at Shelton, 4 chains to the left of North Stafford Infirmary ; thence crossing the Cauldon Canal, 13 chains beyond which the branch to Newcastle and the Grand Junction Railway diverges, the main line thence passing on the left of the Grand Trunk Canal, and approaching the same within 4 chains ; thence crossing the road from Stoke-upon-Trent to Lane-end, 8 chains to the left of the bridge over the Grand Trunk Canal, 10 chains and to the left of New-park, in Trentham parish ; thence nearing the bend in the Grand Trunk Canal, within  $1\frac{1}{2}$  chains, in Barlaston parish ; thence to the left of Park-fields, 9 chains to the right of Little Meaford ; thence twice crossing the same canal in Meaford Township, and curving to within  $1\frac{1}{2}$  chains of Field-place on the right ; thence passing through Stone, 7 chains to the left of the Church, 5 chains to the left of Stone Grange ; thence continuing to Stoke, where the branch to Salt and the Grand Junction Railway diverges on the left ; thence within 6 chains of Aston Hall on the right, curving and recurving through Yarlet extra parochiality, within 2 chains of the new buildings, in the parish of St. Mary's, Stafford, crossing the left portion of Coton-field, within 3 chains of Lammascole, crossing the river Sowe, and joining the Grand Junction Railway, in Rickerscole Township.

#### THE STOCKPORT DEVIATION.

The Stockport divergence commences at Levenshulme ; thence passes in a direct line  $9\frac{1}{2}$  chains to the right of Heaton



Chapel, through Stockport, and crossing the River Mersey, 8 chains to the right of Wellington Bridge; thence with a curve of a mile' radius, passing 11 chains to the right of Adswell Hall, 11 chains to the left of the Mill; thence nearly in a direct line to its junction with the main line in Cheadle Bulkeley Township.

BRANCH No. 1.

FROM GATLEY GREEN TO THE GRAND JUNCTION RAILWAY.

Leaving the main line near Gatley Green, this branch proceeds through Prestbury, Posthern, and Sand-bach parishes, crossing the turnpike-road from Liverpool to London in the latter parish, and the Grand Trunk Canal and the River Wheelock in Elton Township; and thence continues to the Grand Junction Railway, in Crewe Township, 7 chains north of the road to Nantwich.

BRANCH No. 2.

FROM SHELTON TO THE GRAND JUNCTION RAILWAY IN  
MADELEY TOWNSHIP.

This branch commences at Shelton, where it leaves the main line, crosses the Grand Trunk Canal and the road from Newcastle to Hanley, 33 chains from the bridge over the Grand Trunk Canal; thence passing the high ground in Wolstanton Township, by means of a tunnel, and continues to Newcastle-under-Lyne, crossing the turnpike-road from Newcastle to Congleton, and passing 7 chains to the left of the Canal Bridge; thence continuing to Knutton, and under the high ground in Keele parish, by means of a second tunnel; and thence to the Grand Junction Railway in Madeley parish.

BRANCH No. 3.

FROM STOKE TO THE INTENDED STAFFORD AND RUGBY  
RAILWAY, IN RUGELEY PARISH.

This branch diverges from the main line at Stoke, and proceeds in a direct line within 5 chains and to the left of Burston;



thence crossing the Grand Trunk Canal in Sandon parish, keeping to the right of the River Trent, and passing through Salt, and 6 chains to the right of Weston-on-Trent, crosses the Grand Trunk Canal, half-a-mile beyond Weston; thence keeping to the left of the same canal, and curving through Haywood Township, and recurving in Little Haywood and Colwich Townships, again crosses the same canal and the River Trent in Wolseley Township, and meets the intended Stafford and Rugby Railway, in Rugeley parish.

## CURVES.

The curves under three-quarters of a mile' radius in the main line, are, one of 46 chains, near the point of divergence of branch No. 3, and a second of 50 chains' near North Stafford Infirmary.

In branch No. 1 there is one curve of 24 chains' radius, contiguous to the Grand Junction Railway.

In branch No. 2, the worst curves are, one of 15 chains' radius, contiguous to the Grand Junction Railway, one of 37 chains' near the road from Nantwich to Newcastle, and a third of 45 chains.

## GRADIENTS, &amp;c.—MAIN LINE.

Datum—137 feet below Store-street, Manchester.

| Distance from Store-street. |         | Length of each plane. |      | Gradient. | Inclination. | Ascending or Descending. | Locations.                                      |
|-----------------------------|---------|-----------------------|------|-----------|--------------|--------------------------|-------------------------------------------------|
| Miles.                      | Chains. | Ms.                   | Chs. | Feet.     |              |                          |                                                 |
| 6                           | 00      | 6                     | 00   | 9·01      | 1 in 586     | Ascending                | Near Turnpike-road from Stockport to Cheadle.   |
| 17                          | 00      | 11                    | 00   | 6·        | 1 in 880     | Ascending                | Near Turnpike-road from Congleton to Newcastle. |
| 23                          | 00      | 6                     | 00   | 13·16     | 1 in 401     | Ascending                |                                                 |
| 29                          | 40      | 6                     | 40   | 14·       | 1 in 377     | Ascending                | Under Bath Pool—Summit                          |
| 32                          | 40      | 3                     | 00   | 5·33      | 1 in 990     | Descending               | Near Grand Trunk Canal.                         |
| 36                          | 00      | 3                     | 40   | 14·       | 1 in 377     | Descending               |                                                 |
| 40                          | 60      | 4                     | 60   | 5·        | 1 in 1056    | Descending               | Grand Junction Railway.                         |
| 45                          | 00      | 4                     | 20   | 14·       | 1 in 377     | Descending               |                                                 |
| 47                          | 00      | 2                     | 00   |           |              | Level                    |                                                 |
| 50                          | 71      | 3                     | 71   | 11·06     | 1 in 477     | Descending               |                                                 |



GRADIENTS, &c.—BRANCHES.

STOCKPORT DEVIATION LINE.

| Distance from Junction with main line. |         | Length of each Plane |      | Gradient. | Inclination. | Ascending or descending. | Locations.                      |
|----------------------------------------|---------|----------------------|------|-----------|--------------|--------------------------|---------------------------------|
| Miles.                                 | Chains. | Ms.                  | Chs. | Feet.     |              |                          |                                 |
| 3                                      | 00      | 3                    | 00   | 9·01      | 1 in 586     | Ascending                | Road near Castle-st. Stockport. |
| 6                                      | 69      | 3                    | 69   | 5·31      | 1 in 994     | Ascending                | Grand Junction Railway.         |

BRANCH FROM GATLEY TO CREWE.

|    |    |   |     |       |          |            |                                  |
|----|----|---|-----|-------|----------|------------|----------------------------------|
| 8  | 00 | 8 | 00  | 5·97  | 1 in 844 | Descending | Near Allum Brook.                |
| 12 | 0½ | 4 | 0½  | 8·13  | 1 in 649 | Descending | Near River Wheelock.             |
| 13 | 0½ | 1 | 0   | 10·17 | 1 in 519 | Descending |                                  |
| 15 | 68 | 2 | 67½ |       |          | Level      | Grand Junction Railway at Crewe. |

SHELTON AND MADELEY BRANCH.

|   |     |   |     |       |           |            |                                          |
|---|-----|---|-----|-------|-----------|------------|------------------------------------------|
| 0 | 55  | 0 | 55  | 4·96  | 1 in 1064 | Descending | Near Turnpike-road Newcastle to Burslem. |
| 3 | 75  | 3 | 20  | 18·79 | 1 in 281  | Ascending  |                                          |
| 4 | 25¼ | 0 | 50¼ | 7·93  | 1 in 665  | Ascending  |                                          |
| 4 | 55¼ | 0 | 30  | 8·    | 1 in 660  | Descending |                                          |
| 6 | 55  | 1 | 79¾ | 53·33 | 1 in 99   | Descending |                                          |
| 7 | 5   | 0 | 30  | 16·   | 1 in 330  | Descending | Grand Junction Railway.                  |

STONE AND RUGELEY BRANCH.

|    |    |   |    |      |          |            |                                                |
|----|----|---|----|------|----------|------------|------------------------------------------------|
| 5  | 00 | 5 | 00 | 10·  | 1 in 528 | Descending |                                                |
| 9  | 00 | 4 | 00 |      |          | Level      |                                                |
| 11 | 38 | 2 | 38 | 7·81 | 1 in 676 | Descending | Intended Stafford and Rugby Railway at Rugeley |

NOTE.—The Datum for the Stockport deviation is 137 feet below Store-street, Manchester.

For Branch No. 1, 180 feet below Grand Junction Railway at point of Junction.

For Branch No. 2, 11 feet below same Railway at point of Junction.

For Branch No. 3, 240 feet below the Grand Trunk Canal at Rugeley.



## TUNNELS.

In the main line there is one tunnel proposed near Wolstanton, 440 yards in length, and 25 feet high.

In branch No. 2, there are two tunnels proposed, one in Wolstanton township, 990 yards long, 25 feet high, and 139 feet under the summit of hill; and the second, 880 yards long, 25 feet high, and 150 feet below the summit.

## PRINCIPAL EARTHWORKS.

## MAIN LINE.

| Description. | Length. |      | Greatest height<br>or depth. |     | Average height<br>or depth. |    | Locations.                               |
|--------------|---------|------|------------------------------|-----|-----------------------------|----|------------------------------------------|
|              | Ms.     | Chs. | Feet.                        |     | Feet.                       |    |                                          |
| Embankment   | 3       | 0    | ...                          | 30  | ...                         | 16 | End of Viaduct, &c.                      |
| Cutting..... | 1       | 25   | ....                         | 35  | ....                        | 25 | Between 3 and 6 miles.                   |
| Embankment   | 0       | 47   | ....                         | 100 | ....                        | 36 | River Mersey.                            |
| Embankment   | 1       | 67   | ....                         | 50  | ....                        | 24 | Between 6 and 9 miles.                   |
| Cutting..... | 2       | 3    | ....                         | 30  | ....                        | 20 | Between 8 and 11 miles.                  |
| Cutting..... | 0       | 72   | ....                         | 36  | ....                        | 27 | Between 10 and 12 miles.                 |
| Embankment   | 1       | 56   | ....                         | 108 | ....                        | 46 | River Dane.                              |
| Cutting..... | 0       | 75   | ....                         | 52  | ....                        | 25 | Bath Pool, between 29 and<br>31 miles.   |
| Cutting..... | 0       | 64   | ....                         | 47  | ....                        | 28 | Between 33 and 34 miles.                 |
| Embankment   | 1       | 20   | ....                         | 35  | ....                        | 17 | River Trent.                             |
| Embankment   | 1       | 40   | ....                         | 43  | ....                        | 28 | River Trent, between 43 and<br>46 miles. |
| Cutting..... | 2       | 20   | ....                         | 60  | ....                        | 32 | Between 45 and 48 miles.                 |
| Embankment   | 1       | 56   | ....                         | 27  | ....                        | 17 | River Sowe.                              |

The principal earthwork in Branch No. 1, is the River Wheelock embankment, which is 2 miles 68 chains long, and averaging 22 feet high.

The earthworks of Branch No. 2 are not important.

In Branch No. 3, the chief earthworks are the River Trent embankment, 3 miles 35 chains long, and averaging 18 feet high, and the cutting between 8 and 10 miles,  $1\frac{3}{4}$  miles long, and averaging 46 feet in depth.

In the Stockport divergence, the chief earthworks are the Mersey embankment, 35 chains long, and averaging 42 feet



high, and the cutting between Black Brook and the Mersey, 1 mile 5 furlongs in length, and averaging 25 feet deep.

#### CROSSINGS OF ROADS, &c.

According to the Section lodged with the Clerk of the Peace for Stafford, the crossings of the main line consist of twenty-five turnpike-roads, ten to be passed over the railway and fifteen under; sixty-three highways, streets, and parish-roads, thirty-two over and thirty-one under; two occupation-roads under; seven railways and tramways; forty-nine brooks, streams, &c. The Grand Trunk Canal is to be passed four times under, at depths below the rails' surface varying from 15 to 45 feet. The Macclesfield Canal to be passed under the railway 13 feet below the top of rails; the Cauldon Canal to be passed 24 feet above the rails. The rivers to be crossed by the railway are, the Medlock, the Mersey, 103 feet, the Dane, 116 feet, the Trent, 35 feet, and a second crossing of the same river 42 feet, and the Sowe at 29 feet below the rails' top surface in each case, besides two other river crossings.

#### STOCKPORT DEVIATION.

In the Stockport deviation the crossings are, fourteen highways and parish-roads, two occupation-roads, nine streams, and the River Mersey, which is 90 feet below the rails.

#### BRANCH No. 1.

In Branch No. 1 the railway is proposed to cross four turnpike-roads, three to be passed over and one under; twenty-two highways and parish-roads, thirteen over and nine under; two occupation-roads under; eleven brooks, streams, &c. The Grand Trunk Canal to be passed under, and also the rivers Dane and Wheelock.

#### BRANCH No. 2.

The crossings of Branch No. 2 are, three turnpike-roads, two over and one under; eight highways and parish-roads,



six over and two under ; thirteen brooks, streams, &c. The Newcastle higher canal to be passed over the railway at 23 and again at 25 feet above the rails, and the Trent and Mersey Canal to be passed 14 feet 7 inches under the rails.

## BRANCH No. 3.

The crossings of Branch No. 3 are, seven turnpike-roads, two to be passed over and five under ; seventeen highways and parish-roads, two over and fifteen under ; one occupation-road under ; eight brooks, streams, &c. The Grand Trunk Canal to be passed three times, and a branch canal once ; the River Trent to be passed three times under the railway.

## REMARKS.

The whole length of the main line is 50 miles 71 chains, and consists of one level plane, rather more than  $3\frac{3}{4}$  miles from the Grand Junction Railway, and 2 miles in length ; and nine inclined planes, varying in inclination from 1 in 377, or 14 feet per mile, to 1 in 1056, or 5 feet in a mile. In point of gradients, therefore, the whole is exceedingly favourable.

The Stockport Deviation Line is 6 miles 69 chains long, having two planes, also with excellent gradients.

The Gatley and Crewe Branch is 15 miles 68 chains long. Its steepest gradient is 10·17 feet in a mile, or 1 in 519.

The Shelton and Madeley Branch is 7 miles and 5 chains in length, and presents one plane near the Madeley end, rising at the rate of 1 in 99, or 53·32 feet per mile ; the five other planes range in inclination from 1 in 281, or 18·79 feet in a mile, to 1 in 1064, or 4·96 feet per mile.

The Stone and Rugeley Branch is 11 miles 38 chains long, and presents no unfavourable gradients, the first descending from the main line at the rate of 10 feet in a mile, the second level, and the third descending to the intended Stafford and Rugby Railway at Rugeley, with a gradient of 7·81 feet per mile.



The whole length of the main line and branches is 92 miles 11 chains.

The only plane requiring an assistant engine is that in the Shelton and Madeley Branch, which falls at the rate of 1 in 99.

There is one tunnel in the main line, a quarter of a mile in length; and in the branch from Shelton to Madeley there are two tunnels, together 1870 yards long, or 110 yards more than a mile.

The whole length of tunnelling, therefore, in the main line and branches, is  $1\frac{1}{4}$  miles and 110 yards.

The River Dane embankment, and the cutting between 45 and 48 miles, both in the main line, are most worthy of notice.

The number of bridges required for roads, &c., in the main line, is one hundred and eleven, and for brooks and streams, &c., forty-nine, including culverts.

In the Stockport Deviation twenty-six bridges and culverts will be required.

In Branch No. 1 the bridges and culverts are forty-two in number; in branch No. 2 the number is twenty-eight; and, lastly, in the third branch there are forty bridges.

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## MANCHESTER CONNEXION RAILWAY.

J. U. RASTRICK, Esq., Engineer.

The object of this line is to connect the intended Sheffield Railway, and the Manchester, Cheshire, and Staffordshire, or the South Union Railway (the two latter being competing lines), with the Manchester and Liverpool and the Manchester and Bolton Railways. Leaving the Manchester and Liverpool Railway at Ordsall-lane, this line proceeds to the Irwell, which it crosses at  $1\frac{1}{2}$  chains distant from the Manchester and



Liverpool Railway Bridge, over the same river, and thence proceeding across Water-street, Woolham-place, Elm-street, the Duke of Bridgewater's Canal, Castle-field, Knot Mill, Gilbert-street, Collier's-row, Mount-street, Rowe's-street, and skirting Hewitt-street, and passing between Ferneley-street and Hewitt-street, and thence through the dye-works, by Cambridge-street, crosses the River Medlock, which is proposed to be diverted for a short length, and continues through the gas-works' premises; thence skirting Gloucester-street, and crossing Oxford-street, Hunt-street, and Garratt-road, passes between Fishpond-street and Shooter's-brook; thence crosses Sackville-street and the London-road, and curving in a southeasterly direction, terminates at the proposed station of the Manchester, Cheshire, and Staffordshire Railway, in Ashton-street. A short branch diverges at the intersection of the London-road, to the same intended railway, in Chapel-street. The branch to the Manchester and Bolton Railway diverges from the main line at the River Irwell, crosses Ordsall-lane, and the end of Hampson-street, and joins the Manchester and Bolton Railway on the west side of Oldfield-lane.

The curves under three-quarters of a mile' radius are, one of 18 chains, at junction with the Manchester and Liverpool Railway; two of about the same degree of curvature, the one at the junction with the Manchester and Bolton Railway, the other at Cambridge-street; and lastly, one of similar curvature, at junction with the intended Manchester, Cheshire, and Staffordshire Railway,

The main line consists of one level and two inclined planes; the former is at the junction with the Manchester and Liverpool Railway, for 8.95 chains; the next plane ascends at the rate of 1 in 50; and, lastly, that which is the eastern terminal plane, rises at the rate of 1 in 338; the branch to Chapel-street is 7.15 chains long, and falls from the main line at the rate of 1 in 104. The inclinations of the branch to the Bolton Railway are, first, 1 in 205 for a length of 21.70 chains, leaving the Manchester and Bolton Railway; the second plane is level for



3·50 chains ; and lastly, 1 in 50, ascending to the main line or a length of 4·55 chains.

#### CROSSINGS OF ROADS, &c

According to the Section lodged with the Clerk of the Peace at Preston, the main line passes over twenty-nine streets, at elevations varying from 18 to 46 feet, including Water-street, which is 27 feet, and the London-road, which is 28 feet, under the top surface of rails ;—it also crosses the rivers Irwell and Medlock, the former at an elevation of 41 and the latter at 61 feet above the water's surface of each. The Bridgewater Canal is thrice crossed, and Ordsall-lane is proposed to be passed on the level.

The branch to the Bolton Railway passes 14 feet under Old-field-lane, which is to be raised 4 feet and carried over the railway.

#### REMARKS.

The whole length of the main line and branches is 2 miles 8·90 chains ; the worst gradient of the main line is 105·60 feet per mile, or 1 in 50, for a length of 28 chains.

The whole of this railway, except those portions in the Township of Salford, is to be constructed on a series of arches—the clear average height of which would be almost 25 feet, and the minimum clear height near the eastern terminus, about 15 feet, supposing horizontal iron bearers to be used.

In the month of July last we viewed a line, having partly the same object as the present plan, but extending its utility still further, by connecting the Manchester and Leeds Railway, and through its medium the whole of the manufacturing districts of Rochdale, Todmorden, and Halifax, as well as the Yorkshire Railways, in addition to those which the Manchester Connexion Railway is intended to unite. The general levels which we had taken on the occasion, of the most difficult portion of the line, from St. George's-road to the Manchester and Bolton Railway, gave us a plane inclining at the rate of 1 in 100. The general direction of its route from the Manchester and Bolton Railway is across the Bank Parade, leaving St. Philip's Church on the left ; thence crossing the Broughton-road and the River Irwell ; thence passing to Strangeways, and crossing the River Irk, leaving Lacey's stables on the right, crossing St. George's-road and proceeding to the station of the Manchester



and Leeds Railway, in Lees-street; thence continuing across the Oldham-road, Bengal-street, Blossom-street, Great Ancoat-street, and crossing the Ashton Canal, terminates at the station of the intended Sheffield Railway, and other proposed Railways from the south, in Store-street. The whole length of this line is about  $2\frac{3}{4}$  miles.

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## MANCHESTER AND LEEDS RAILWAY.

### INTENDED VARIATIONS.

GEO. STEPHENSON, THOS. L. GOOCH, ESQRS., Engineers.

#### VARIATION No. 1.

##### LANCASTER AND YORK.

This variation commences at Moston Brook, in the county of Lancaster, and curves past Boar Green, about 5 chains to the east, and approaches Great Nuthurst and close to Wash Pits; thence continuing in a direct line and passing to Mills Hill, 7 chains to the west of the Rochdale Canal, crosses the same 3 chains to the north of Coney Green Lock; thence to the east of Higher Boarshaw, about 4 chains to the west of Touchet Hole; thence again crossing the canal and bearing to the east of Gorsey Lea, nearing the canal within  $1\frac{1}{2}$  chains on the west side thereof, and passing about 30 chains to the north of Slat-tocks; thence crossing the Branch Canal 9 chains from its entrance into the Rochdale Canal, and running to the west of Blue Pits; thence to within 9 chains of Castleton Hall, which is on the west, and slightly curving through Rochdale, crosses the Werneth and Littleborough turnpike-road a little to the east of the Toll House, and west of Holland Houses; thence between Belfield Hall and the Print Works, and running nearly parallel and within  $1\frac{1}{2}$  chains of the Rochdale Canal, for about 26 chains in length, in the Township of Butterworth; thence crossing the turnpike-road to Halifax, near Littleborough Church, and running between the Littleborough and Todmor-



den Turnpike-road and the Canal, passes to within 10 chains of the Summit Inn, and through the high ground, by means of a tunnel 6,930 feet long, and continuing in a straight line in a direction a little to the west of north, passes from the north end of the tunnel to near the Sun Inn; thence proceeding in front of Clough Mill, and close to the turnpike-road, and curving through Gaulxholme, very nearly in the same direction as the present Parliamentary line, and crossing the Canal by the Lock House, on the west, instead of the east side thereof. It now passes along to Todmorden, within  $3\frac{1}{2}$  chains of the Church, which is on the south, and traverses the Burnley Turnpike-road near the original point of crossing: from thence the line is traced to the north side of Castle-street, running nearly parallel therewith, crossing Castle Hill near Lobb Mill, and re-crossing it at about 8 chains further. It again crosses the turnpike-road to the east of Studley Bridge, and passing to Bottoms, runs along the line of the turnpike-road, and passes close to Myrtle Grove Chapel; thence in front of Rawden Hall, and curving to Charleston Cottages, crosses the turnpike-road and canal nearly in the same direction as in the original line; then curving close to the south of Weasel Hall, runs upon the River Calder, which is to be diverted near Hebden Bridge, and keeps a tolerably direct line to Mytholm Royd, crossing Cragg Brook, and the turnpike road nearly as before.

From Mytholm Royd the line is kept to the south of the River Calder, which is again to be diverted for about a quarter of a mile; thence crossing to the north of Bragg Hall, and to the north of Hand Carr Mill, and passing east of Blackwood Hall, and close to Boy Scar Mill, proceeds to the south of Long Bottom Mill; thence to Sowerby Bridge, and curving close to Naylor's Mill, which is left on the north, crosses the river beyond Stern Mills, and recrossing the same about a quarter of a mile below Copley Bridge, passes to the north of Dean Wood, crosses the Halifax and Stainland Turnpike-road, and falls into the original line on the east side thereof.



## VARIATION No. 2

## YORK.

This variation commences near the Calder Iron Works, close to the river, and curving to the north of Thornhill Lees Hall, crosses the Calder and Hebble Navigation, and Forge Lane; thence to Lees House, and to the north of the Double Locks on the same navigation, nearly in a direct line to Healy Low Mill, which is passed a little to the south; thence close to Storrshill Colliery, and to the north of Foster's Mill; thence curving to the south of Horbury, and joining the original line in a Willow Garth, in the Township of Horbury.

## CURVES.

The curves are generally about 70 chains' radius, and some about a mile.

## GRADIENTS, &amp;c.—DEVIATION No. 1.

| Distance from<br>Terminus at<br>Manchester. |         | Length of<br>each plane. |       | Gradi-<br>ent. | Inclina-<br>tion. | Ascending or<br>descending. | Locations.                                                                      |
|---------------------------------------------|---------|--------------------------|-------|----------------|-------------------|-----------------------------|---------------------------------------------------------------------------------|
| Miles.                                      | Chains. | Ms.                      | Chs.  | Feet.          |                   |                             |                                                                                 |
| 7                                           | 65      | 5                        | 37·40 | 32·19          | 1 in 164          | Ascending                   | To Heywood Branch<br>of Rochdale Canal.                                         |
| 8                                           | 28      | 0                        | 43    |                |                   | Level                       | Blue Pits.                                                                      |
| 10                                          | 12      | 1                        | 64    | 16·29          | 1 in 324          | Ascending                   |                                                                                 |
| 11                                          | 68      | 1                        | 56    |                |                   | Level                       |                                                                                 |
| 14                                          | 78      | 3                        | 10    | 16·            | 1 in 330          | Ascending                   | Entrance of Long<br>Tunnel.                                                     |
| 16                                          | 23      | 1                        | 25    | 9·96           | 1 in 530          | Ascending                   | Long Tunnel.                                                                    |
| 16                                          | 38      | 0                        | 15    |                |                   | Level                       | Summit Plane.                                                                   |
| 22                                          | 70      | 6                        | 32    | 29·01          | 1 in 182          | Descending                  | Hebden Bridge.                                                                  |
| 30                                          | 53      | 7                        | 63    | 14·            | 1 in 377          | Descending                  | Junction with original<br>line near Halifax and<br>Stainland Turnpike-<br>road. |

## DEVIATION No. 2.

|    |    |   |    |       |           |            |                                              |
|----|----|---|----|-------|-----------|------------|----------------------------------------------|
| 40 | 7  | 0 | 67 | 9·56  | 1 in 552  | Descending | Calder and Hebble<br>Navigation.             |
| 41 | 1  | 0 | 74 | 10·81 | 1 in 488  | Descending | Calder and Hebble<br>Navigation.             |
| 43 | 38 | 2 | 37 | 10·66 | 1 in 497  | Descending | Turnpike-road, Wake-<br>field to Austerland. |
| 45 | 07 | 1 | 49 | 4·96  | 1 in 1064 | Descending | Junction with the ori-<br>ginal line.        |



## TUNNELS.

| Nos.     | Length.<br>Feet. | Height. | Locations-                           |
|----------|------------------|---------|--------------------------------------|
| 1 .....  | 6930 .....       | 21 .... | Summit.                              |
| 2 .....  | 535 .....        | 21 .. . | Between Gaulxholme and<br>Todmorden. |
| 3 . .... | 660 .....        | 21 .... | Near Hebden Bridge.                  |
| 4 .....  | 264 .....        | 21 .... | Near Luddenden Foot.                 |
| 5 .....  | 1468 .....       | 21 .... | Near Sowerby Bridge.                 |

## PRINCIPAL EARTHWORKS.

| Description. | Length.<br>Ms. Chs. | Greatest height<br>or depth.<br>Feet. | Average height<br>or depth.<br>Feet. | Locations.                                             |
|--------------|---------------------|---------------------------------------|--------------------------------------|--------------------------------------------------------|
| Cutting .... | 1 60 ....           | .....                                 | 27 ...                               | Near Moston Brook to Ack-<br>rington Colliery Railway. |
| Embankment 1 | 60 ....             | 70 .....                              | 24 ...                               | Mills Hill.                                            |
| Embankment 2 | 40 ....             | . ....                                | 28 ...                               | Littleborough.                                         |
| Cutting .... | 30 ....             | 70 .....                              | 40 ...                               | South end of long Tunnel.                              |
| Cutting .... | 49 ....             | .....                                 | 58 ...                               | About 29 miles, parish of<br>Halifax.                  |

In the second divergence, the only earthwork worthy of note, is a cutting about 44 miles from Manchester, which is 64 chains long, and averaging about 40 feet in depth.

## CROSSINGS OF ROADS, &amp;c.

## VARIATION No. 1.

The crossings of the first variation consist of sixteen turnpike-roads, seven to be passed over and nine under the railway; twenty-three public roads and parish roads, nine over and fourteen under; fifty-two occupation roads, thirty-one over and twenty-one under; thirty-seven foot-paths, fifty-five brooks, streams, &c. The Rochdale Canal to be passed seven times under, at from 14 to 25 feet below the rails' top surface, and once over at 13 feet above the rails. The Ackrington Colliery Railway to be raised 4 feet 6, and passed on the level.



There are three crossings of the River Calder, one of the Irk, and one of the River Beale, and three level crossings.

## VARIATION No. 2.

The crossings of the second variation are one turnpike-road to be passed over the railway, four parish roads and highways, three to be passed over and one under; twelve occupation-roads, five over and seven under; four foot-paths, one railway, and one level crossing. The Calder and Hebble Navigation to be twice crossed by the railway, at an elevation of 20 feet above the water's surface in each case.

The River Calder is twice passed over by the railway.

## REMARKS.

The whole length of the first diversion is 28 miles and 35·40 chains, arranged in six inclined and three level planes, the former varying in inclination from 1 in 164, or 32·19 feet per mile, to 1 in 530, or 9·96 feet in a mile, and the latter amounting in length to 2 miles 34 chains.

The worst gradients are of the plane rising to the Heywood Branch of the Rochdale Canal at the rate of 1 in 164, and of that falling to Hebden Bridge at the rate of 1 in 182; the remaining gradients are severally 16·29, 16·00, 14·00, and 9·96 feet per mile.

The length of the second deviation is 5 miles 67 chains, and is divided into four planes with extremely favourable gradients, the steepest falling at the rate of 10·81 feet per mile.

The curvature of each of the variations is considerably less than that which characterises the original line, there being no curves with less radius than 70 chains, or 7 furlongs.

There are five tunnels proposed in the first variation, whose collective length is 1·86 miles, or 3285 yards.

The extent of tunnelling is greater than in the original Parliamentary line, by 734 yards.

The heaviest embankment in the first divergence is that at



Littleborough, which is about  $1\frac{1}{2}$  miles in length, and averaging about 28 feet in height: the chief cutting is about 29 miles, in Halifax parish, 49 chains in length, and averaging about 58 feet in depth. There is only one earthwork in the second divergence worthy of notice: it is a cutting rather more than three-quarters of a mile in length, and averaging 40 feet in depth.

The bridges required for roads, &c. are one hundred and fifty-one; and the bridges and culverts for brooks, streams, &c. fifty-five in number. Those for the second divergence are twenty-seven in number.

The height allowed for turnpike-roads over the railway is 14 feet 6 inches, and for those under 15 feet, allowing 4 feet in each case for the depth of arch and road, or railway formation.

The Rochdale Canal to be diverted at Winterbut Lee, for a short length. The proposed diversions of the River Calder are, one at Hebden Bridge, a second near Mytholm Royd, a third near Hand Carr Mill, and, lastly, one near Long Bottom Mill.

Considering the Manchester and Leeds Railway one of the most important Lines in the country, in a commercial point of view, and presenting as many difficulties in the Engineer's department as any other Railway, either projected or in progress, we have great pleasure in subjoining the following account:—

A plan for a Railway between the important Towns of Manchester and Leeds was first agitated in 1830. The Committee then appointed to further the preliminary measures for an application to Parliament in the following Sessions, applied both to Mr. Walker and Mr. Stephenson, the Engineers, to give their opinions and report generally on the most favourable line to be selected between the two points.

Surveys were accordingly directed by each of the Engineers; the line preferred by Mr. Walker was that most favorable for the non-interference with valuable property, for directness, and the avoiding of tortuous lines; but it presented some gradients which would now be considered unfavourable, and a considerable length of tunnelling.

The line recommended by Mr. Stephenson, on the other hand, passed through some of the most luxuriant pastures, and amid some of the most valuable Mills



and Factories in the West Riding of Yorkshire, and the eastern part of Lancashire, and following almost entirely the sinuosities of the Vale of Todmorden, naturally presented a great variety of objectionable curves, but owing to the immense population of the district, and its importance in a commercial point of view, it was considered upon the whole the most advisable plan.

At that time, however, the line extended no further than Sowerby Bridge, from which place a junction line was proposed to be extended to the then intended Leeds and Bradford Railway.

The application to Parliament, in the following Session, was at that time unsuccessful, and the plan was suffered to lie dormant till the latter part of 1835, when a new impulse seemed to be given to the Railway system. It was scarcely mentioned by some influential gentlemen of Manchester, before all the shares were secured, and as many more applied for, and we believe, that not a single preliminary advertisement ever appeared in the journals of the day.

Mr. Stephenson, whose services were engaged upon this occasion, acted as principal Engineer; and Mr. Gooch and Mr. Whishaw, as assistant Engineers, in preparing the estimates, and taking all the requisite preliminary steps for the proceedings in Parliament.

#### PROCEEDINGS IN PARLIAMENT, Session 1836.

This plan was violently opposed in the Committee of the House of Commons, by the Proprietors of the Rochdale Canal, and of the Calder and Hebble, and Aire and Calder Navigations, as well as by certain merchants and others, of the Town of Leeds, as well as by several land owners along the line.

In the Standing Orders' Committee especially, it was firmly contested by the Canal Companies, but each of the opposing parties, in turn, yielded to the decision of the Committee, which was, that the Standing Orders had been complied with.

The Rochdale and Calder and Hebble Companies afterwards entirely withdrew their opposition, having obtained for themselves restrictive clauses to be inserted in the act; but the Aire and Calder Company, violently opposed to all Railways in the neighbourhood of its navigation, kept up a determined opposition the whole time the measure was pending in the Committee of the House of Commons, and for some days, also, during the sittings of the Lords' Committee, which continued for eight days; on the sixth day, however, the petitioners, when asked if they intended to produce evidence, or bring forward any case before the Committee, declined doing so, and forthwith abandoned their opposition, having succeeded, however, in obtaining a clause in the bill for suspending, for eighteen months, the power of constructing that portion of the Railway lying between Altofts and Leeds, in order to produce, if possible, a better line.

The line of 1835-36 commences at Lees-street, Saint George's-fields, Man-



chester, a little to the west of the Oldham-road, and passes by Collyhurst and Moston, and a little to the east of Middleton; thence approaches near to Slattocks and Blue Pits, and passes to Lower-place, near Rochdale; thence continuing to the south-east of Littleborough, and encountering the high ground a mile beyond that place, and near the summit of the Rochdale Canal; thence passing nearly in a right line to Gaulxholme, where it curves among the factories and other buildings round to Todmorden, and recurves to Castle-street; from thence proceeding by Woodmill and Charleston, to Hebden Bridge, and following the Valley of the Calder, by Mytholm Royd and Luddenden Foot, to Sowerby Bridge; whence, with an easy curve, it is continued to the north of Elland, and winding through Strangstrey Wood, passes through Rastrick, and is continued slightly curving to near Cooper Bridge, Ledgard Bridge, and Shepley Bridge, and Thornhill Lees; from this place it is traced through the Meadows south-east of the Calder to Horbury Bridge; and thence, to Thornes and Wakefield.

From Wakefield to Methley two lines were proposed, one through the Township of Stanley-cum-Wrenthorpe, the other by Normanton, which latter was selected as being the most preferable in point of direction, and less interference with the property of contending parties.

At Normanton, a junction is intended with the proposed North Midland and York, and North Midland Railways. From Methley the line is almost direct to Woodlesford, and thence running near the course of the Aire, curves round by Haigh Park, and traverses the Fields parallel with the Wakefield and Leeds turnpike-road, continuing nearly in the same direction past Hunslet, to its termination on the north bank of the River Aire, at Leeds.

The Gradients of this line are as follows: commencing at Manchester for a length of

| Miles. | Chains | Inclination.                                          | Gradients. Feet. | Locations.                   |
|--------|--------|-------------------------------------------------------|------------------|------------------------------|
| 4      | 19     | the line rises at the rate of 1 in 165 or 32 per mile |                  |                              |
| 1      | 03·50  | .....                                                 | 1 in 528 or 10   | „                            |
| 4      | 32·50  | .....                                                 | 1 in 165 or 32   | „                            |
| 1      | 35     | which is level.                                       |                  |                              |
| 2      | 51     | .....                                                 | 1 in 277 or 19   | „                            |
| 2      | 22     | .....                                                 | 1 in 555 or 9·50 | „ East end of Summit Tunnel. |

This brings the line to the east end of the Summit Tunnel, to which point the above planes are, with the exception of about  $1\frac{1}{2}$  miles of level, altogether ascending; the next plane descending from the summit for a length of

| Miles. | Chains. | Gradients. Feet per Mile.             | Locations.        |
|--------|---------|---------------------------------------|-------------------|
| 0      | 61      | descends at the rate of 1 in 586 or 9 |                   |
| 3      | 67      | .....                                 | 1 in 130 .. 40·50 |



| Miles. Chains. |     | Gradients.     |                | Locations.                              |  |
|----------------|-----|----------------|----------------|-----------------------------------------|--|
|                |     | Feet per Mile. |                |                                         |  |
| 1              | 67½ | 1 in           | 528 .. 10      |                                         |  |
| 3              | 56½ | 1 in           | 277 .. 19      |                                         |  |
| 2              | 06  | 1 in           | 660 .. 8       | Sowerby.                                |  |
| 6              | 19  | 1 in           | 440 .. 12      |                                         |  |
| 2              | 20  | 1 in           | 528 .. 10      | Cooper Bridge.                          |  |
| 1              | 15  | 1 in           | 586 .. 9       |                                         |  |
| 5              | 43  | 1 in           | 660 .. 8       |                                         |  |
| 1              | 44  | 1 in           | 352 .. 15      |                                         |  |
| 2              | 50  | 1 in           | 5280 .. 1      |                                         |  |
| 0              | 34  | 1 in           | 528 .. 10      |                                         |  |
| 2              | 42  | Ascending      | 1 in 754 .. 7  | Junction with North<br>Midland Railway. |  |
| 2              | 43  | Descending     | 1 in 352 .. 15 |                                         |  |
| 4              | 74  | Ascending      | 1 in 1320 .. 4 |                                         |  |
| 1              | 43  | Descending     | 1 in 1320 .. 4 |                                         |  |
| 1              | 02  | Ascending      | 1 in 1760 .. 3 | River Aire at Leeds.                    |  |

The total distance from the one terminus to the other, being 60 miles 50 chains ; and the length in a right line 35 miles.

The nature of the country through which this line passes, necessarily involves a great number of curves, which, in the line we are describing, vary from about a quarter of a mile to 3 miles' radius ; but one grand object in the two intended variations already described, is to get rid of all the curves of small radius, there being none less than of about 70 chains.

Some of the earthworks are heavy, particularly the cutting near Moston, which contains upwards of 900,000 cubic yards ; the Slattock's cutting, about 800,000 cubic yards ; the Littleborough embankment, and that near Elland, each upwards of 400,000 cubic yards ; the cutting near Wakefield 385,000 yards ; and the Altoft's embankment, 485,000 cubic yards. The top of the embankments, and bottom of cuttings, is proposed to be 11 yards in width ; the slopes generally 1½ to 1, the strata being exceedingly favorable, except in the neighbourhood of Slattocks, where the slopes are taken at 2 to 1 ; the strata consisting of clay, sand, and gravel.

The total quantity of excavation is estimated at upwards of 6,400,000 cubic yards ; and of embankment, 6,100,000 ; of these quantities 1,200,000 yards were intended to be disposed of in spoil ; and 625,400 to be obtained from side cuttings, which are readily obtained in almost every part of the districts traversed by this line.

Two hundred and fifty thousand cubic yards, being about the largest quantity which has been turned over an embankment in one year in other large works of a similar kind ; and the largest of the embankments in this line, containing less than 500,000 yards ; it is evident that three years, as stated by the Engineers



when before Parliament, is ample time for the completion of the whole, from the time of first breaking ground, the average lead not exceeding three-quarters of a mile.

The Tunnels are four in number, one at the summit near Littleborough, 1705 yards, or nearly a mile in length; one at Winterbut Lee, 126 yards in length; one at Mytholm, about 440 yards; and one at Elland, 280 yards; altogether 2551 yards in length; the height of each to be 21 feet in the clear, and the width 25 feet; the longest tunnel is in clay, sand-stone, shale, and bind. The ventilation to be effected by six vertical shafts; the gradient of this tunnel is  $9\frac{1}{2}$  feet per mile. The level of the Rochdale Canal, near this place, is about 30 feet above the top of the intended Tunnel.

The Masonry and Brickwork, throughout this line, form an important item in the estimates; there being sixteen canal crossings, nine river crossings, twenty-three turnpike-road crossings, besides one hundred and fifty-six bridges for highways, tramways, and railways, and those for occupation: many of these crossings are very oblique. Besides these, there are three important Viaducts:—viz. one in the Manchester terminal plane of 54 arches, from 12 feet to 30 feet in span, crossing several streets in Saint George's Fields, at an average elevation of 23 feet; the Gauxholme Viaduct, consisting of 18 and 30 feet arches, the average height being 16 feet; and the Wakefield Viaduct, consisting of twelve arches, eleven of which are 30 feet in span; and that over Kirkgate-street, 20 feet as to its middle opening, besides two side openings, each of 6 feet. There are eleven public carriage-roads to be crossed on a level.

The rails are taken at 50 pounds per yard, and the chains at 18 pounds each.

In the estimate delivered into the Committee of the House of Commons in April last, the

|                                                                                                     |             |
|-----------------------------------------------------------------------------------------------------|-------------|
| Earthworks were set down at .....                                                                   | £.360,570   |
| Masonry .....                                                                                       | 226,579     |
| Stations .....                                                                                      | 10,000      |
| Culverts .....                                                                                      | 18,231      |
| Alterations to Roads and Streams .....                                                              | 4,626       |
| Tunnels .....                                                                                       | 74,255      |
| Fencing .....                                                                                       | 21,340      |
| Formation of Way, including rails, chairs, keys<br>and pins, felt, blocks, sleepers, and ballasting | 268,875     |
| Contingencies, nearly 12 ½ cent .....                                                               | 115,518     |
|                                                                                                     | <hr/>       |
|                                                                                                     | 1,100,000   |
| Land and Buildings .....                                                                            | 200,000     |
|                                                                                                     | <hr/>       |
|                                                                                                     | £.1,300,000 |

This gives £21,487. 12s. per mile.

The facilities of bringing materials to this work are superior to those of most



of the other proposed railways, the line running parallel with turnpike-roads and canals for nearly the whole length; the blocks for rails will be obtained to a considerable extent in many of the cuttings and neighbouring quarries, which produce stone of a hard and durable character.

The Ballasting for the whole line, will easily be obtained within the limits of the property required for the railway.

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## MANCHESTER SOUTH UNION RAILWAY.

G. STEPHENSON, Esq., Engineer.

G. P. BIDDER, Esq., Acting Engineer.

This line is proposed to commence at the meeting of Store-street with the London Road, Manchester, and cross Boad-street, Travis-street, Fairfield-street, the River Medlock, Harriett-street, Rock-street, Crane-street, Chapel Field-road, Hol-lym-street, Union-street, Heaton-street, Thornhill-street, Cross-street, Chancery-lane, and Blind-lane; thence crossing the turnpike-road from Manchester to Sheffield, 23 chains east of the toll-bar; thence parallel with the turnpike-road from Manchester to Stockport, 7 chains east of Crowcroft House; thence curving to within 15 chains east of the Pack-horse Inn, crossing the same turnpike-road 30 chains to the south; thence keeping to the west of the turnpike-road to Stockport, passing close by Bower House, crossing Heaton-lane and the River Mersey,  $8\frac{1}{2}$  chains west of Wellington Bridge; thence across Chester-gate, Edgeley-road, Greek-street,  $6\frac{3}{4}$  chains from the turnpike-road to Buxton and Macclesfield, across Longhurst-lane, within  $3\frac{1}{4}$  chains of the same turnpike-road; thence through the townships of Bramhall and Norbury, 27 chains west of the Crescent Inn at Poynton; thence to Hol-lingworth Smithey, and near Mill House; thence within 6 chains west of Bradley Row, and east of Prestbury, pass- ing through the Township of Titherington, east of the River Bollin, close by Higher Beech Hall, within 2 chains, by means



of a gallery,  $10\frac{1}{2}$  chains in length ; thence curving to the town of Macclesfield, crossing the end of Brunswick-street, and pursuing, in part, the line of the River Bollin, crossing Brook-street,  $1\frac{1}{4}$  chains east of the River Bollin ; thence across Lunt Hill-road, close to Messrs. Woods' manufactory, and cutting the River Bollin ; thence crossing the turnpike-road to Leek, 7 chains south of the toll-bar, within 2 chains of the Macclesfield Canal, across Dean's Moss, within 3 chains west of Moat's House, 6 chains west of the Riddings,  $7\frac{1}{2}$  chains east of Walley Wood, crossing Walley Clough, at a quarter of a mile beyond which the branch curves off to Leek ; thence within 19 chains of the Wheatsheaf Inn, on the road to Congleton ; 8 chains east of Crosslidge, crossing the Macclesfield Canal ; thence to Key Green ; thence crossing the east end of Park-lane, at its meeting with the road to Leek and Congleton ; thence crossing Nickabarrow-lane, 20 chains from the Macclesfield Canal, east of Woodhouse, between Higher and Lower Bank ; thence within 2 chains west of Lea Hall ; thence crossing the road from Lawton to Burslem, within  $1\frac{1}{4}$  chains west of Wolstanton Church, within 1 chain east of Clough Hall, in the parish of Audley, passing through these grounds by means of a gallery 23 chains long ; thence crossing the Bath Pool, within 1 chain of Harecastle Wood ; thence by Chatterby Farm and Long Bridge Hays, crossing Longport,  $4\frac{1}{2}$  chains west of the chapel ; thence within 22 chains of the canal-bridge at Etruria, and 10 chains to the left of Stoke Church, curving to the Grand Trunk Canal, which it skirts in the Township of Fenton Culvert ; thence within 10 chains to the left of New Park, in the Township of Trentham, and within 10 chains and to the right of Little Meaford, cutting the Grand Trunk Canal in the Township of Meaford, which is proposed to be diverted for about 15 chains ; thence 2 chains to the left of Meaford Old Hall, a quarter of a mile beyond which the Birmingham Branch goes off,  $1\frac{1}{2}$  chains to the left of Field-place ; thence crossing the Town of Stone,



6 chains to the left of St. Michael's Church; from thence the line proceeds within 3 chains and to the left of Stone Grange. At Stoke the Liverpool Branch goes off; the main line now keeping between the turnpike-road to Lichfield, and the Grand Trunk Canal. It now passes to Binston; thence within 29 chains to the right of Sandon, touching the right bank of the River Trent, at Salt, 11 chains to the left of Weston Church, 25 chains to the left of Shirley Wick Salt-works; thence through the intermixed parishes of Stowe and Colwich, 5 chains to the west of Bank Top, at Anson's Row; thence 3 chains to the left of Colton Mill, and keeping to the left of the River Trent, 6 chains to the right of Cowardan Spring, through Mickle Meadow; thence crossing the River Trent, 11 chains beyond which the branch to Alrewas diverges; thence within 9 chains and on the left of the Brick-yard, in the parish of King's Bromley, 5 chains to the right of Ashton Hay, cutting off the corner of Haunch Wood, within five chains and on the left of Brook Hay; thence crossing the Town of Whittington, crossing the Coventry Canal, in the parish of St. Michael's, Lichfield, which is intended to be diverted for 24 chains; thence near to Tamhorn House, which is on the right; across Staffordshire Moor, and passing within 18 chains of Tamworth Church, meets the Birmingham and Derby Junction Railway, at an angle of about  $82^{\circ}$  and  $31\frac{1}{2}$  chains from Bole Bridge.

The branch to Leek leaves the main line, near Lane End, in Prestbury parish, passes  $1\frac{1}{2}$  chains to the right of Broad Oak, 2 chains to the left of Lower Wood, 2 chains to the left of Clough House, 3 chains to the right of Moore's Green, crossing the River Dane; thence within 8 chains of Rushton Mill, 11 chains to the left of Rushton Chapel, and skirting Rudyerd Reservoir, 19 chains to the left of West Wood, and terminating at the Canal Basin, by the road to Leek. There is a curve in this branch of 30 chains' radius.

The branch from the main line, near Stone, to the Grand



Junction Railway, near Hammer Houses, leaves the Grand Junction Railway near the Hammer Houses, and passes within 8 chains east thereof; thence proceeding 7 chains west of Norton Farm, 3 chains south-east of Elysium, crossing Filly Brook; thence curving to its junction with the proposed South Union Railway, within 15 chains of Meaford Old Hall.

The branch from the proposed South Union Railway, near Stone, to the Grand Junction Railway, near Mill Meece, leaves the main line near the Brass-works, at Stone, and passes between the Windmill and Dole Meadow; thence to the right of Walton Manor House, 8 chains to the right of Elysium, about 7 chains from Yarnfield, 9 chains south of Cold Meece Mill, to its junction with the Grand Junction Railway, near Mill Meece.

The Alrewas Branch leaves the main line near Armitage, and passes 5 chains to the left of Armitage Church, 5 chains to the right of March Barn; thence in a direct line 8 chains north of the Common Barn, in the parish of Alrewas Hay, crossing the Grand Trunk Canal, within 16 chains to the right of Alrewas, 10 chains to the right of Alrewas Cottage; thence curving within 14 chains of Wichnor Forge, to its junction with the intended Birmingham and Derby Junction Railway, in the parish of Tatenhall.



## GRADIENTS, &amp;c.—MAIN LINE.

Datum—Ten Feet above Level of Sea.

| Distance from<br>Store-street,<br>Manchester. |         | Length of<br>each Plane |      | Gradi-<br>ent. | Inclina-<br>tion. | Ascending or<br>Descending. | Locations.                                                   |
|-----------------------------------------------|---------|-------------------------|------|----------------|-------------------|-----------------------------|--------------------------------------------------------------|
| Miles.                                        | Chains. | Ms.                     | Chs. | Feet.          |                   |                             |                                                              |
| 1                                             | 16½     | 1                       | 16½  | 9·96           | 1 in 530          | Ascending                   | T. P. Road to Hyde.                                          |
| 2                                             | 32½     | 1                       | 16   | 10·            | 1 in 528          | Ascending                   |                                                              |
| 6                                             | 7¼      | 3                       | 54¾  | 13·85          | 1 in 381          | Ascending                   | Edgeley Road.                                                |
| 12                                            | 00      | 5                       | 72¾  | 16·09          | 1 in 328          | Ascending                   | Near turnpike-road to<br>Stockport.                          |
| 17                                            | 00      | 5                       | 00   | 20·            | 1 in 264          | Ascending                   | Brook-street, Mac-<br>clesfield.                             |
| 19                                            | 48½     | 2                       | 48½  | 16·14          | 1 in 327          | Ascending                   |                                                              |
| 22                                            | 3½      | 2                       | 35   | 9·02           | 1 in 585          | Descending                  | Near River Dane.                                             |
| 22                                            | 23½     | 0                       | 20   |                |                   | Level                       |                                                              |
| 24                                            | 22½     | 1                       | 79   | 5·03           | 1 in 1049         | Descending                  |                                                              |
| 24                                            | 63¼     | 0                       | 40¾  |                |                   | Level                       | Turnpike-road, from<br>Leek to Congleton.                    |
| 26                                            | 23      | 1                       | 39¾  | 6·68           | 1 in 790          | Ascending                   |                                                              |
| 31                                            | 39½     | 5                       | 16½  |                |                   | Level                       |                                                              |
| 33                                            | 65½     | 2                       | 26   | 15·08          | 1 in 350          | Descending                  | Near turnpike - road<br>from Newcastle to<br>Burslem.        |
| 35                                            | 65½     | 2                       | 00   | 12·51          | 1 in 422          | Descending                  | Near turnpike - road<br>from Newcastle to<br>Hanley.         |
| 36                                            | 76¼     | 1                       | 10¾  |                |                   | Level                       | Turnpike-road to Lane<br>End.                                |
| 38                                            | 26½     | 1                       | 30¼  | 12·33          | 1 in 428          | Descending                  |                                                              |
| 39                                            | 46¼     | 1                       | 19¾  |                |                   | Level                       |                                                              |
| 42                                            | 23½     | 2                       | 57¼  | 9·94           | 1 in 531          | Descending                  |                                                              |
| 44                                            | 49¼     | 2                       | 25¾  | 15·95          | 1 in 331          | Descending                  |                                                              |
| 44                                            | 78¾     | 0                       | 29½  |                |                   | Level                       | Turnpike - road to<br>Stafford.                              |
| 48                                            | 62½     | 3                       | 63¾  | 10·01          | 1 in 527          | Descending                  |                                                              |
| 49                                            | 57½     | 0                       | 75   |                |                   | Level                       | Trent and Mersey<br>Canal.                                   |
| 50                                            | 70½     | 1                       | 13   | 5·16           | 1 in 1023         | Descending                  |                                                              |
| 51                                            | 75¾     | 1                       | 5¼   |                |                   | Level                       |                                                              |
| 53                                            | 77¼     | 2                       | 1½   | 4·95           | 1 in 1065         | Ascending                   |                                                              |
| 56                                            | 42½     | 2                       | 45¼  | 11·70          | 1 in 451          | Descending                  |                                                              |
| 58                                            | 35¾     | 1                       | 73¼  |                |                   | Level                       |                                                              |
| 59                                            | 22      | 0                       | 66¼  | 7·25           | 1 in 728          | Descending                  |                                                              |
| 59                                            | 67      | 0                       | 45   |                |                   | Level                       |                                                              |
| 60                                            | 36½     | 0                       | 49½  | 9·70           | 1 in 544          | Ascending                   | Grand Trunk Canal.                                           |
| 62                                            | 42      | 2                       | 5½   | 4·83           | 1 in 1092         | Ascending                   | Near turnpike-road<br>from King's Brom-<br>ley to Lichfield. |
| 64                                            | 23½     | 1                       | 61½  |                |                   | Level                       |                                                              |
| 66                                            | 49¾     | 2                       | 26¼  | 13·75          | 1 in 384          | Descending                  |                                                              |
| 68                                            | 24½     | 1                       | 54¾  |                |                   | Level                       | Coventry Canal.                                              |
| 69                                            | 41      | 1                       | 16½  | 15·76          | 1 in 335          | Descending                  |                                                              |
| 71                                            | 46      | 2                       | 5    |                |                   | Level                       | River Anker, at Tam-<br>worth.                               |



## GRADIENTS, &amp;c., OF BRANCHES.

## LEEK BRANCH.

| Distance from Junction with Main Line. |         | Length of each Plane |     | Gradient. | Inclination. | Ascending or Descending. | Locations.            |
|----------------------------------------|---------|----------------------|-----|-----------|--------------|--------------------------|-----------------------|
| Miles.                                 | Chains. | Ms.                  | Chs | Feet.     |              |                          |                       |
| 0                                      | 39½     | 0                    | 39½ | 12·16     | 1 in 434     | Ascending.               | Macclesfield Canal.   |
| 4                                      | 61½     | 4                    | 22  | 16·14     | 1 in 327     | Ascending.               | To Rudyerd Reservoir. |
| 6                                      | 13¾     | 1                    | 32¼ |           |              | Level.                   | To South end of same. |
| 9                                      | 0¼      | 2                    | 66½ | 16·19     | 1 in 326     | Descending               |                       |
| 9                                      | 28½     | 0                    | 28¼ | 14·19     | 1 in 372     | Ascending                | Canal Wharf at Leek.  |

## BRANCH—STONE TO THE HAMMER HOUSES.

|   |     |   |     |       |          |           |                                                     |
|---|-----|---|-----|-------|----------|-----------|-----------------------------------------------------|
| 1 | 68½ | 1 | 68½ | 16·70 | 1 in 316 | Ascending | Yarnfield Moss.                                     |
| 3 | 69½ | 2 | 1   | 10·43 | 1 in 506 | Ascending | Junction of the main line and branch to Birmingham. |

## BRANCH—STONE TO MILL MEECE.

|   |     |   |     |      |           |            |                                                  |
|---|-----|---|-----|------|-----------|------------|--------------------------------------------------|
| 1 | 12¾ | 1 | 12¾ | 4·31 | 1 in 1224 | Ascending  | Near Turnpike - road from Stafford to Newcastle. |
| 3 | 32½ | 2 | 19¾ |      |           | Level      | Yarnfield Moss.                                  |
| 4 | 69¾ | 1 | 37¼ | 3·41 | 1 in 1547 | Descending | Grand Junction Railway.                          |

## ALREWAS BRANCH.

|   |     |   |     |       |          |            |                                             |
|---|-----|---|-----|-------|----------|------------|---------------------------------------------|
| 1 | 8   | 1 | 8   | 15·48 | 1 in 341 | Descending | Turnpike-road from Lichfield.               |
| 3 | 56¾ | 2 | 48¾ | 8·43  | 1 in 626 | Descending |                                             |
| 5 | 26¼ | 1 | 49½ |       |          | Level      | Grand Trunk Canal.                          |
| 7 | 29  | 2 | 2¾  | 10·33 | 1 in 511 | Descending | River Trent.                                |
| 7 | 54¾ | 0 | 25¾ |       |          | Level      | Junction with Derby and Birmingham Railway. |

## GALLERIES AND VIADUCTS.

The proposed Hare Castle Gallery is  $24\frac{1}{2}$  chains long, and 30 feet high; that near the River Bollin,  $9\frac{1}{2}$  chains long, and also 30 feet high.

The proposed Viaduct at Manchester, is 63 chains long



and about 20 feet high; that of the River Dane,  $\frac{1}{4}$  of a mile long, and about 110 feet high; and, lastly, the Mersey Viaduct at Stockport, is 80 feet high.

#### EARTHWORKS.—MAIN LINE.

| Description. | Length. |      | Greatest height<br>or depth. |       | Average height<br>or depth. |     | Locations.                              |
|--------------|---------|------|------------------------------|-------|-----------------------------|-----|-----------------------------------------|
|              | Ms.     | Chs. | Feet.                        |       | Feet.                       |     |                                         |
| Embankment   | 17      | .... | 54                           | ..... | 35                          | ... | North side of Stockport<br>Viaduct.     |
| Cutting .... | 3       | 20   | ....                         | ..... | 13                          | ... | South of Stockport.                     |
| Cutting ...  | 2       | 50   | ....                         | 86    | .....                       | 55  | Dean's Moss.                            |
| Cutting .... | 1       | 34   | ....                         | 54    | ...                         | 26  | .. About 29 miles.                      |
| Cutting .... | 1       | 12   | ....                         | 54    | .....                       | 30  | ...                                     |
| Embankment   | 2       | 50   | ....                         | ..... | 20                          | ... | About 35 miles.                         |
| Cutting .... | 1       | 3    | ....                         | 58    | .....                       | 28  | ... Junction with Birmingham<br>Branch. |
| Embankment   | 4       | 40   | ....                         | ..... | 10                          | ... | At 49 miles.                            |
| Cutting .... | 2       | 7    | ....                         | 62    | .....                       | 36  | . Between 53 and 56 miles.              |
| Embankment   | 2       | 8    | ....                         | ..... | 14                          | ... | About 58 miles.                         |
| Cutting ...  |         | 38   | ....                         | 64    | .....                       | 40  | ... Near same.                          |

#### CROSSINGS OF ROADS, &c.

The crossings of the main line consist of twenty-five turnpike-roads, nine to be passed over and sixteen under the railway; one hundred and twenty-six highways, public and parish-roads, seventy-eight over and forty-eight under; fifty-six occupation-roads, twenty-eight over and twenty-eight under; thirty foot-paths; eighty-six streams, brooks, &c. The Derby and Birmingham intended Railway is thirteen feet above the rails' top surface, and there are four other crossings of railways. The canal crossings consist of that of the Macclesfield, 38 feet under, three crossings of the Trent and Mersey under, 12 and 17 feet below the rails' respectively. The Grand Trunk Canal 12 feet under, and one to be diverted.

The Wyerley and Essington Extension Canal to be passed 15



feet under the rails, and the Coventry Canal to be thrice passed under, at 12 feet below the rails' top surface.

The rivers to be crossed by the railway are the Medlock, the Mersey, the Bollin, three times over and three times under the Dane, five crossings of the Trent, one of the Tame, one of the Anker, and three other crossings.

Three turnpike-roads are proposed to be diverted, and six other roads, and there is one level crossing.

In the Leek branch there are two turnpike-roads to be passed over the railway, seven highways and parish-roads, four over and three under; eight occupation-roads, six over and two under; ten brooks, streams, &c. The Macclesfield Canal to be passed over at an elevation of 33 feet above the rails; the River Dane to be once crossed over, and the Churnet six times.

In the Alrewas branch there are three turnpike-roads, two to be passed over and one under; five highways and parish-roads, two over and three under; twenty occupation-roads under; four foot-paths; twelve streams, brooks, &c. The Grand Trunk Canal to be crossed over by the railway, at an elevation of 12 feet above the rails, and the river Trent to be thrice passed under.

In the branch from near Stone to the Grand Junction Railway, the crossings consist of three turnpike-roads, one to be passed over the railway and two under; four highways and parish-roads, three over and one under; three foot-paths; five brooks, streams, &c.

The Grand Trunk Canal to be passed under, at 12 feet below the rails, and the River Trent to be twice passed under.

In the Stone and Mill Meece branch there are two turnpike-roads under; four highways and parish-roads, three to be passed over and one under; one foot-path, and twelve drains and streams; and the Grand Trunk Canal to be passed under, 33 feet below the rails.



## REMARKS.

The whole length of the main line is 71 miles 46 chains, and is divided into thirty-six planes, of which thirteen are level, and amount in length to 18 miles 57 chains, and the gradients of the latter range from 20 feet to 4·83 feet per mile.

The steepest gradient is 20 feet in a mile for five miles, in the plane ascending to Macclesfield.

The Leek branch is 9 miles  $28\frac{1}{2}$  chains in length, and consists of five planes, of which one is level, for 1 mile  $32\frac{1}{4}$  chains, and the inclinations of the latter range from 1 in 326 to 1 in 434, or 16·19 feet per mile, to 12·16 feet in a mile; the steepest inclination therefore in this branch is 1 in 326.

The branch from the main line to the Hammer Houses is 3 miles  $69\frac{1}{2}$  chains long, and consists of one plane, ascending to Yarnfield Moss at the rate of 1 in 316, and the other, also ascending to its junction with the Grand Junction Railway, near the Hammer Houses, at the rate of 1 in 506.

The branch from Stone to Mill Meece is 4 miles  $69\frac{3}{4}$  chains in length, and consists of one level plane, 2 miles  $19\frac{3}{4}$  chains in length, and two inclined planes, with gradients of 4·31 and 3·41 feet per mile.

The Alrewas branch is 7 miles  $54\frac{3}{4}$  chains in length, and is divided into two level planes, together 1 mile  $75\frac{1}{4}$  chains in length, and three other planes, inclining at the rate of 1 in 341, 1 in 511, and 1 in 626.

The Manchester terminal plane ascends from the station, and that at Tamworth is level.

The Leek branch presents a curve of 30 chains' radius at its termination in Leek parish.

There are two galleries proposed, one near Harecastle, 539 yards long and 30 feet high, and a second near the the River Bollin, 209 yards long and of the same height.

The viaducts proposed are three in number, one at Manchester about 126 yards long and about 20 feet high; the Mer-



sey viaduct at Stockport, which is 80 feet high, and the River Dane viaduct, about 440 yards long and 110 feet high.

The heaviest embankment is about 35 miles from Manchester, 2 miles 50 chains long, and averaging 20 feet in height; and the principal cutting is at Dean's Moss, 2 miles 50 chains in length, and averaging 55 feet in depth.

In the branch to the Grand Junction Railway, near the Hammer Houses, the Yanfield Moss cutting is 1 mile 73 chains in length, and averaging about 14 feet in depth.

In the branch to Mill Meece, the River Trent embankment is 1 mile 50 chains in length, and averaging about 14 feet in height.

The bridges required for rivers, roads, and canals, &c. in the main line, are two hundred and seventy, and the bridges and culverts for streams, &c., eighty-six in number.

In the branches, the whole number of bridges and culverts required is one hundred and eight.

The clear height allowed for turnpike-road arches under the railway, is 15 feet 6 inches, and of arches over the railway, 12 feet 6 inches, allowing 3 feet 6 inches in each case for the depth of arch and ballasting, &c.

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## MARYPORT AND CARLISLE RAILWAY.

GEORGE STEPHENSON, Esq., Engineer.

This line joins the Newcastle and Carlisle Railway at the west-end of Botchergate, Carlisle, and running south of the River Caldew, crosses the same at the junction of the Townships of Blackhall Low, and Blackhall High; thence keeping north of the river, and within a quarter of a mile north of Dalston, and proceeds in a westerly direction; and, thence curving to the south-west, and pursuing nearly the course of the River Wainpool; thence continuing in a westerly di-



rection, and passing north of Wigton, 4 chains south of Brookfield, in the Township of Waverton High, a quarter of a mile north of Oak-rigg; thence crossing the River Waver, in the Township of Waverton High, 16 chains north of Crookdale Hall; thence curving nearly in a south-westerly direction to Aspatria, and continuing in a direct course through the Township of Aspatria, as far as the road from Gilcrux to Oughterside, crossing the River Ellen three times in the parish of Plumbland, and crossing the same river about twenty times in the Townships of Birkby and Dearham; thence keeping south of the river, in the Township of Ellenborough, and pursuing a nearly north-easterly course, within 5 chains of the Irish Sea, terminates on the east side of the Basin at Maryport.

## CURVES.

The curves under three-quarters of a mile' radius, are one of 48 chains, in the Township of Crosby; a second, of half-a-mile, in the same Township; a third, of 43 chains, in the Township of Dearham; a fourth, of half-a-mile, in the Townships of Maryport, Dearham, and Birkby; and, lastly, two of 15 chains' radius each, in the Township of Ellenborough.

## GRADIENTS, &amp;c.

Datum—Average High Water, South Quay, Maryport.

| Distance from Maryport. |         | Length of each plane. |      | Gradient. | Inclination. | Ascending or Descending. | Locations.                      |
|-------------------------|---------|-----------------------|------|-----------|--------------|--------------------------|---------------------------------|
| Miles.                  | Chains. | Ms.                   | Chs. | Feet.     |              |                          |                                 |
| 0                       | 66      | 0                     | 66   | 6.06      | 1 in 871     | Descending               | Newcastle and Carlisle Railway. |
| 2                       | 75      | 2                     | 9    | 17.54     | 1 in 301     | Ascending                |                                 |
| 9                       | 35½     | 6                     | 40½  | 19.27     | 1 in 274     | Ascending                |                                 |
| 15                      | 20      | 5                     | 64½  | 12.75     | 1 in 414     | Descending               |                                 |
| 17                      | 5½      | 1                     | 65½  | 25.38     | 1 in 208     | Descending               |                                 |
| 19                      | 31½     | 2                     | 26   |           |              | Level.                   |                                 |
| 22                      | 2       | 2                     | 50½  | 14.83     | 1 in 356     | Ascending                |                                 |
| 24                      | 2       | 2                     |      | 8.50      | 1 in 621     | Ascending                |                                 |
| 28                      | 1       | 3                     | 79   | 15.75     | 1 in 339     | Descending               |                                 |



## CROSSINGS OF ROADS, &amp;c.

According to the Section lodged with the Clerk of the Peace for Cumberland, the crossings consist of seven turnpike-roads, six to be passed over the railway, and one under ; twenty highways and parish-roads, sixteen over and four under ; sixteen occupation-roads, fourteen over and two under ; fifteen brooks, becks, and streams, and two level crossings.

The rivers proposed to be crossed by the railway are, the Ellen, twenty-three times, the Waver, the Wisa, the Wampole twice, and the Caldew, which are severally to be passed under.

## REMARKS.

The whole length of this line is 28 miles 1 chain, and is arranged in nine planes, of which, one is level for 2 miles 26 chains, and the rest varying in point of gradient, from 25·38 feet per mile, or 1 in 208, to 6·06 per mile, or 1 in 871.

The steepest plane is that of 1 in 208, and extends for 1 mile 65½ chains ; the gradients, therefore, may be considered favorable.

The Maryport terminal plane is on a descent from that place ; and the eastern terminal plane is on an ascent from the Newcastle and Carlisle Railway.

The curves under  $\frac{3}{4}$  of a mile' radius are six in number ; the earthworks are not important, the chief being a cutting near Aspatria, 2 miles 10 chains in length, 34 feet in extreme height, and averaging 18 feet.

The bridges required for roads, &c., are seventy-three, and the culverts and bridges, for brooks streams, &c., fifteen in number ; the clear height allowed for roads under the railway is 12 feet 6 inches, and for arches over the railway 11 feet 6 inches, allowing 3 feet 6 inches, in each case, for the arch and ballasting, &c.



## MIDLAND COUNTIES' RAILWAY.

PROPOSED EXTENSION TO THE NORTH MIDLAND  
RAILWAY.

CHARLES VIGNOLES, Esq. M.R.I.A. Civil Engineer.

This extension commences on the north-side of Cranfleet Cut, 13 chains to the east of its entrance into the River Trent, and passes about 8 chains to the west of Long Eaton; thence west of Beshill-lane, and parallel thereto, at a distance of about 6 chains; 3 chains to the west of Sand-acre Church, 15 chains to the west of Moor Bridge; thence parrallel with and on the west of the Erwash Canal, and crossing the same beyond Little Hallam Field; thence crossing the River Erwash, 15 chains to the west of Trowell Mill, and passing within 2 chains of the Nottingham Canal, by Grange Wood; thence proceeding between it and the River Erwash, again passing within 2 chains of the canal, near Millfield-lane, 6 chains to the east of Bennersley Bridge, close to the Blob Inn, and nearly parallel with the Nottingham Canal for about three-quarters of a mile, in Cossall and Nuthall parishes; thence continuing a little to the west of Newthorpe Common, crossing the Nottingham Canal just beyond, and keeping to the east of the same; thence passing close to the village of Eastwood, which is on the west, 17 chains to the east of Beggarlee Wharf, 9 chains to the east of Brinsley Wharf Row; thence to Whelps Dale, about 36 chains to the east of Alfreton iron works, close and on the east of Muckroom Hole, 16 chains to the west of Cornfield Hall, 7 chains to the west of Sherland Park Buildings, 6 chains to the east of Pasture House, 12 chains to west of the buildings at Doe Hill, 10 chains to the east of Hagg House; thence curving to Padley Wood, and re-curving towards Wingfield Mill, leaving it 12 chains to the east; thence passing Coneygree House on the west, within 12 chains of North Wingfield



Church, and proceeding to its junction with the North Midland Railway, 35 chains from Anchor Bold, in North Wingfield parish.

### CURVES.

The curves under three-quarters of a mile' radius are, one of 50 chains at Eastwood, one of the same radius at Whelp's Dale, and, lastly, one of half-a-mile in Morton parish.

### GRADIENTS, &c.—MAIN LINE.

Datum—Level of the Sea.

| Distance from Junction with Midland Counties' Railway. |         | Length of each plane. |      | Gradient. | Inclination. | Ascending or descending. | Locations.                                              |
|--------------------------------------------------------|---------|-----------------------|------|-----------|--------------|--------------------------|---------------------------------------------------------|
| Miles.                                                 | Chains. | Ms.                   | Chs. | Feet.     |              |                          |                                                         |
| 1                                                      | 40      | 1                     | 40   | 4         | 1 in 1320    | Ascending                |                                                         |
| 2                                                      | 50      | 1                     | 10   |           |              | Level                    |                                                         |
| 3                                                      | 56      | 1                     | 6    | 15.85     | 1 in 333     | Ascending                |                                                         |
| 5                                                      | 35      | 1                     | 59   | 12.11     | 1 in 436     | Ascending                |                                                         |
| 5                                                      | 55      | 0                     | 20   |           |              | Level                    |                                                         |
| 8                                                      | 75      | 3                     | 20   | 17.54     | 1 in 301     | Ascending                |                                                         |
| 10                                                     | 27      | 1                     | 32   | 14.30     | 1 in 369     | Ascending                |                                                         |
| 16                                                     | 16      | 5                     | 69   | 17.60     | 1 in 300     | Ascending                | North end of Tunnel                                     |
| 17                                                     | 10½     | 0                     | 74½  |           |              | Level                    |                                                         |
| 19                                                     | 51½     | 2                     | 41   | 17.95     | 1 in 294     | Ascending                |                                                         |
| 22                                                     | 50      | 2                     | 78½  | 18.20     | 1 in 290     | Descending               | Junction with North Midland Railway at North Wingfield. |

There are two tunnels proposed, one at 16 miles from the Midland Counties' Railway, half-a-mile in extent; the other 600 yards, at 20 miles' distance from the same railway.

The earthworks are comparatively slight.

The following Table exhibits the length, number of planes, and steepest inclination of each of the Branches.

| Nos. | Description.           | Length. |      | No. of Planes. | Steepest Inclination. |
|------|------------------------|---------|------|----------------|-----------------------|
|      |                        | Ms.     | Chs. |                |                       |
| 1    | Nottingham Branch..... | 2       | 55   | 2              | 1 in 405              |
| 2    | Eastern Line.....      | 2       | 57   | 1              | 1 in 440              |
| 3    | Ilkestone Branch ..... | 0       | 69   | 2              | 1 in 46               |



| Nos. | Description.                         | Length.<br>Ms. Chs. |     | No. of<br>Planes. |      | Steepest<br>Inclination. |
|------|--------------------------------------|---------------------|-----|-------------------|------|--------------------------|
| 4    | Shelley Branch .....                 | 1                   | 09  | 3                 | .... | 1 in 54½                 |
| 5    | Babbington Branch .....              | 0                   | 18¾ | 2                 | .... | 1 in 50                  |
| 6    | Nuthall Branch.....                  | 0                   | 39½ | 2                 | .... | 1 in 105                 |
| 7    | Newthorpe Branch.....                | 0                   | 45  | 2                 | .... | 1 in 54                  |
| 8    | Stonyford Branch .....               | 0                   | 24¾ | 2                 | .... | 1 in 45                  |
| 9    | Butterley Branch .....               | 1                   | 68½ | 2                 | ...  | 1 in 240                 |
| 10   | Mansfield and Pinxton Railway Branch | 1                   | 46  | 1                 | .... | Level                    |
| 11   | Ridding's Branch .....               | 0                   | 39  | 1                 | .... | 1 in 660                 |
| 12   | Pinxton Branch .....                 | 1                   | 7   | 2                 | .... | 1 in 180                 |
| 13   | Hucknall Branch .....                | 4                   | 23½ | 13                | .... | 1 in 12                  |
| 14   | Normanton Branch .....               | 1                   | 77  | 5                 | .... | 1 in 23                  |
| 15   | Nether Birch Wood Branch .....       | 0                   | 25  | 2                 | .... | 1 in 89                  |
| 16   | Western Line .....                   | 1                   | 36  | 2                 | .... | 1 in 300                 |
| 17   | North Wingfield Variation.....       | 2                   | 63  | 2                 | .... | 1 in 121                 |

## CROSSINGS OF ROADS, &amp;c.

The crossings, according to the Section lodged with the Clerk of the Peace for Leicester, consist of eight turnpike-roads, five to be passed over the railway and three under ; seventeen highways and parish-roads, eleven over and six under ; six occupation-roads, two over and four under ; four foot-paths ; nine railways and tramways ; thirty brooks, streams, &c.

The canals to be crossed by this railway are the Erwash, at 11 feet below the rails ; two crossings of the Nutbrook Canal, at 10 feet under ; the Nottingham at 10 feet, and the Cromford at 25 feet below the rails' top surface, at each crossing respectively.

The rivers to be crossed over by the railway are the Erwash, at four separate places, and the Rother.

## REMARKS.

The whole length of the main line is 22 miles 50 chains, and consists of three level planes, amounting in length to 2 miles 24 chains, and eight inclined planes, whose gradients range from 18·20 feet per mile, or 1 in 290, to 4 feet in a mile, or 1 in 1320. There are, therefore, no planes in the main line requiring either stationary or assistant engines.



The branches and practical variations are seventeen in number, and amount in length to 24 miles 63 chains ; the planes vary in inclination, from 1 in 12, to 1 in 3000, and many of them will require to be worked either by the stationary or self-acting system, and others may be worked by horses.

The curves in the main line under three-quarters of a mile' radius, are three in number. In the branches there are several quick curves.

The whole length of tunnelling in the main line is 1480 yards. In the Western line there is a tunnel proposed 39 chains long, and in the North Wingfield variation the tunnel is 600 yards long.

The bridges required for roads, rivers, and canals, &c., in the main line, are sixty-three, and the bridges and culverts for brooks, streams, &c., thirty in number. The clear height allowed for turnpike-road arches over the railway is 12 feet 6 inches, and for those under, 14 feet 6 inches, allowing in each case 3 feet 6 inches for the thickness of arch, and ballasting, &c.

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## NORTHERN AND EASTERN RAILWAY.

CONTINUATION FROM CAMBRIDGE TO YORK.

JAMES WALKER, F.R.SS. L. and E., A. BURGESS, ESQRS., Engineers.

This line commences at the intended depôt of the London and Cambridge Railway, near the River Cam, at Cambridge, crosses that river, and passes within 24 chains and to the east of the Observatory ; thence nearly in a direct line through the parishes of Oakington and Long Stanton, within 4 chains to the east of Willingham West Mill, and taking the Dog Houses in its route, cuts off the north-west



angle of Willingham Common Field ; thence proceeding about 2 chains to the west of Erith, and 15 chains to the west of Erith Mill, a little to the East of Colne Windmill, 12 chains to the east of Pegspitt Bridge, near Somersham ; thence within a quarter of a mile of Chapel Head, in Pidley Fen, continuing in a direct line across Warboys Fen, and passing within  $17\frac{1}{2}$  chains of the bridge over the Forty-feet Drain ; thence skirting the west side of Ramsey Mere, and still continuing in a direct line, and within 12 chains to the right of King's Delph Mill, across Whittlesea Common Field, 27 chains to the east of the Ball public-house, 25 chains to the east of Northey Gravel Ferry House ; proceeding thence in a slightly-curving course between Eastwood Farm and the village of Eye, leaving the latter about 30 chains to the east ; thence intersecting North Wood, and continuing in a direct course to the River Welland, which it crosses within 24 chains of Walderham Hall on the left, it now runs nearly parallel with the northern branch of the Welland, for about  $1\frac{1}{2}$  miles, passes a little to the left of Frognall ; thence 15 chains to the left of Sheepskin Hall, in the parish of St. James's, Deeping, 12 chains to the east of Five Houses Farm, now slightly curving through Baston and Thurlby parishes, passing close to the Toll-bar, by Bourn Outgang, within a few chains of Dyke's Haw Spring ; thence within 8 chains of Bromwell Spring ; thence continuing to within 35 chains and to the right of Swaton, half a mile to the left of Heckington Church, within 50 chains of Ewerby Thorpe, crossing the Sleaford Canal, near the bend in the Catchwater-drain, in the parish of Ewerby ; thence within 25 chains of the Lock ; thence within 52 chains of Anwick Church on the left, and within a quarter of a mile of Anwick Grange, and 8 chains of State House, both on the left, across Digby Common, leaving the largest portion thereof to the left ; thence within 22 chains of Martin Moor Farm House, 11 chains to the left of Barp Farm and Nocton Wood, 32 chains to



the right of the Plough and Horses public-house, in the parish of Nocton, skirting the south-east corner of Hanworth Wood, near the Plough public-house, in the parish of Branston; thence to the east of Washingborough, nearly parallel with the turnpike-road; thence to the west of the Decoy, in the Lordship of Skillingthorpe, 12 chains to the east of Skillingthorpe Wood, 15 chains to the west of Saxelby; thence in a direct line to Brampton, which is left about 5 chains to the right; thence continuing in a direct line to the River Trent, which is crossed about a mile from Torksey Church, and running parallel with the Trent, and at about 15 chains' distance, for a short length, crosses the road from Littleborough to Sturton-le-Steeple, 33 chains to the left of the Toll-bar in the Township of Littleborough; thence slightly curving to within 8 chains of Burton Mill, and across Bole Field, within 10 chains of Swandby on the right, and 3 chains of Beckingham Mill on the left, 7 chains to the left of Walkeringham Mill, 8 chains to the right of Walkeringham Wharf, on the Chesterfield Canal; thence 17 chains to the left of Haxey Grange, crossing Folly Drain and Idle Drain, about 16 chains from their junction; within 10 chains of the Engine House, in the parish of Misson, 15 chains to the right of the Four Scores; thence to the intersection of the Woodhouse and Gatewood Road with the Woodhouse Sewer, continuing to Hatfield Mill, 5 chains to the right of Hatfield Parks, crossing the canal at 26 chains to the left of Stainforth Bridge; thence across the River Don, and proceeding to Balne and to the left of Heck, continuing nearly in a direct line, 30 chains to the right of Hat Green, 37 chains to the left of Rowle Hall, crossing the River Aire, and passing about 30 chains to the left of Hambleton Mill, crossing the Leeds and Selby Railway, and thence slightly curving to Ley's House, and passing within 11 chains of Acaster Selby, which is on the right, 16 chains to the right of Bad Rudding Green, and 9 chains to the left of Broad Lane End, skirting the Garden of Eden on the right, and meeting the proposed York



and North Midland Railway, near Bond Hill Ash, at the intersection of the turnpike-road from Tadcaster to York.

There are four branches proposed to diverge from the main line, two on the north and two on the south side, to the Leeds and Selby Railway.

The earthworks are very slight, a great proportion of the embankments averaging not more than from 5 to 8 feet in height.

#### GRADIENTS, &c.

This line is arranged in sixty-one level and inclined planes, of which twenty-one are level, and amount in length to 86 miles  $21\frac{1}{2}$  chains, and the gradients of the latter range from 10 feet in a mile, or 1 in 528, to 3 feet in a mile, or 1 in 1760; the whole length of the line from the intended station of the Northern and Eastern Railway at Cambridge, to the York and North Midland Railway, near Bond Hill Ash, being 140 miles 55 chains.

The branches to the Leeds and Selby Railway, are four in number, amounting in length to 5 miles 48 chains, and the inclinations are 1 in 777 and 1 in 792.

#### CROSSINGS OF ROADS, &c.

The crossings, according to the section lodged with the Clerk of the Peace for the West Riding of York, consist of eighteen turnpike-roads, seventeen to be passed over the railway and one under; one hundred and twenty-five highways and parish roads, seventy-four over and fifty-one under; sixty eight occupation-roads, eight over, and sixty under; nine footpaths; the Leeds and Selby Railway to be passed over at an elevation of 16 feet 6 inches above the rails' top surface; one hundred and nine dykes, brooks, streams, leams, lodes, &c. and one level crossing.

The canals to be passed under the railway are the Sleaford,



at 13 feet under ; the Foss Navigation, the Chesterfield, the Knottingley, at 15 feet below the rails, and one other canal under.

The rivers to be passed under the railway, are the Cam at 12 feet ; the Ouse, at 14 feet ; the forty-foot River, at 12 feet 6 inches ; Bevils River, at 12 feet ; the Welland, at 17 feet ; the Glen, the Witham, the Trent, the Old Don, at 9 feet 5 inches ; the Went ; the Aire, at 12 ; and the Wharfe ; besides three crossings of the Nen, and one other river crossing.

In the branches there are fourteen crossings of roads, &c.

#### REMARKS.

The whole length of this line and branches is 146 miles 23 chains, and is arranged in twenty level planes, whose collective length is 86 miles  $21\frac{1}{2}$  chains, and forty-four inclined planes, with gradients varying from 10 feet per mile, or 1 in 528, to 3 feet in a mile, or 1 in 1760.

The steepest plane, therefore, is 1 in 528, which causes so little loss of mechanical power to the engines, as scarcely to be worthy of notice.

The earthworks are slight, the curvature unobjectionable, and it is entirely free from tunnels and viaducts.

The embankments across the Fens, we imagine, are intended to be formed from side cuts ; and from our knowledge of this country, we can speak confidently of the solidity of the banks at present existing.

There are two hundred and fifty-six bridges required for the main line for roads, rivers, canals, &c.; and one hundred and nine bridges and culverts for streams, &c. The clear height allowed for arches under the railway, is 16 feet, and for those over the railway, 14 feet 6 inches.

The whole distance from London to York by this line is about 194 miles.

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## NORTH MIDLAND RAILWAY.

## PROPOSED DIVERSIONS.

GEORGE STEPHENSON, Esq., Engineer.

FREDERICK SWANWICK, Esq., Assistant Engineer.

## DIVERSION No. 1.

## COUNTY OF DERBY.

This divergence from the main line commences opposite Duffield Church, 2 chains to the West thereof, skirts the east side of the road to Milford, nearing the River Derwent, within a chain, and proceeding to the north-west of Moscow, passes on the east of Swainsley Court, partly by a tunnel; and thence crosses the Derwent, 16 chains to the north-east of Swainsley Court, traverses Belper, and again crosses the same river within a quarter of a mile of the Bridge, continuing in nearly a north-easterly direction, and crossing the river twice beyond Belper, joins the original line 5 chains past the north-eastern side of the River Derwent.

There is a tunnel proposed in this branch  $37\frac{1}{2}$  chains long, and about 25 feet high, near Swainsley Court, which is about 230 feet below the summit of ground, and a cutting about 1 mile 10 chains in length, and averaging about 20 feet in depth.

## DIVERSION No. 2.

This diversion commences at the east end of the Tunnel in the parish of South Wingfield, and passes 8 chains to the north of Wire Mill, joining the original Parliamentary line, 30 chains west of Toad Hole Furnace.

## DIVERSION No. 3.

This divergence from the main line commences  $32\frac{1}{2}$  chains to the north-east of the turnpike-road from Mansfield to Chester-



field, and within 13 chains of the Church, crosses the Chesterfield Canal, about 8 chains to the south of the road to Birmingham, touches the Canal about 70 chains from its junction with the Parliamentary line, crossing it at 12 chains from the bend thereof, in Newbold Township, and joining the Parliamentary line  $17\frac{1}{2}$  chains to the east of the road to Dunston.

## DIVERSION No. 4.

The commencement of this diversion is about 12 chains north-west of Killamarsh Forge, curving to the south of east, and recurving in a north-easterly direction; thence crosses the River Rother five times, and joins the Parliamentary line 19 chains north-east of the road from Beighton to Aston, and about 3 chains south-east of the River Rother.

## NORTH WINGFIELD BRANCH.

This branch commences 24 chains to the east of the south-east angle of the Wood in North Wingfield parish, passing to the west of Wingfield, and 10 chains therefrom, curving through Pitsley Township, to its termination in a field near that place.

There are two curves in this branch under three-quarters of a mile' radius, one of 40, and the other of 11 chains.

## BUTTERLEY BRANCH.

This branch joins the North Midland Railway, near Bull Bridge, passes to the east of Buckland Hollow; thence curving towards the road from Derby to Ripley, and recurving in a north-easterly direction, runs parallel with the Cromford Canal, in Pentridge parish, for nearly a quarter of a mile, and thence southward, to its termination at Butterley Iron Works.

There are two curves under three-quarters of a mile' radius in this branch, one of 10, the other of 15 chains.



## GRADIENTS, &amp;c.

## DIVERSION No. 1.

The length of this diversion is 4 miles 46 chains, and ascends at the rate of 1 in 475, or 11.11 feet per mile.

## DIVERSION No. 2.

This divergence is 2 miles 44 chains in length, and rises at the rate of 1 in 388, or 13.60 feet per mile.

## DIVERSION No. 3.

This deviation is one descending plane, inclining at the rate of 1 in 328, or 16.09 feet per mile.

## DIVERSION No. 4.

The gradient of this diversion is 7.97 feet per mile, or 1 in 662, and is on a descending plane.

## NORTH WINGFIELD BRANCH.

This branch is 1 mile 69 chains in length, and is arranged in one level plane, 5 chains in length, and three inclined planes, with gradients of 48, 4.21, and 88 feet per mile.

## BUTTERLEY BRANCH.

The Butterley branch is 2 miles 52 chains in length, and consists of one level plane, 6 chains long, and three other planes, with inclinations of 1 in 355, 1 in 228, and 1 in 19.89.

## REMARKS.

The unfavorable inclinations are in the two proposed branches, one in the North Wingfield branch, inclining at the rate of 1 in 60, and a second in the Butterley branch, at the rate of 1 in 19.89; both these may be worked either by horse-power, or by the stationary system; and there is one locomotive plane, whose gradient is 48 feet per mile.

There is a tunnel in the Belper divergence, 825 yards long, and 230 feet below the summit of ground.



## OXFORD AND GREAT WESTERN UNION RAILWAY.

J. K. BRUNEL, Esq., F.R.S. Engineer.

This line leaves the Great Western Railway, near Vauxhall Farm, in Didcot Parish, Berks; passes to the left of Appleford; thence crossing the River Isis, into Oxfordshire, and proceeding in a direct line through Culham parish, again crossing the same river, and passing 18 chains to the right of Upper Rudley, leaving the road from Kennington to Abingdon on the left; thence again crossing the Isis, and passing on to Iffley; thence continuing to its termination at the road from Oxford to Cowley.

The branch to Abingdon leaves the main line in Rudley parish, and passes nearly in a direct line across Abbey Gardens, and thence to its termination at Stert-street, Abingdon.

The curves under three-quarters of a mile' radius, are one in the main line, leaving the Great Western Railway, of 44 chains, and two in the Abingdon branch, one of 30 and the other of 8 chains' radius.

### GRADIENTS, &c.

The length of the main line is 9 miles 51 chains, and has one plane, level for 1 mile 70 chains, and three planes inclining at the rate of 1 in 1614, 1 in 1274, and 1 in 1568.

The Abingdon branch has one level plane, and one inclined plane, falling from the main line at the rate of 10 feet in a mile, or 1 in 528.



The heaviest embankment in the main line is that joining the Great Western Railway, and is  $2\frac{1}{2}$  miles in length, and averaging about 15 feet in height; and the chief cutting is at Iffley, 60 chains long, and averages 22 feet in depth.

The Abingdon branch is slightly embanked.

#### CROSSINGS OF ROADS, &c.

The crossings, according to the section lodged in the Private Bill Office, consist of two turnpike-roads to be passed over the railway; twelve highways and parish roads over; three occupation roads, one over and two under; three footpaths, three brooks, streams, &c. and two level crossings.

#### REMARKS.

This line is 9 miles 51 chains in length, and consists of one level plane, whose length is 1 mile 70 chains, and three inclined planes, with gradients ranging from 4.14 feet per mile, or 1 in 1274, to 3.27 feet in a mile, or 1 in 1614.

The steepest plane is in the branch to Abingdon, and inclines at the rate of 1 in 528, or 10 feet per mile. The whole of the gradients therefore are extremely favorable.

There are three curves under three-quarters of a mile' radius.

The principal earthworks are the embankment leaving the Great Western Railway, and the Iffley cutting.

The bridges required for roads, rivers, &c. in the main line and branch, are twenty-four, and the bridges and culverts for brooks, streams, &c., three in number; and there are two roads to be diverted.

The clear height allowed for arches over the railway is 13 feet 6 inches.

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## PORTSMOUTH JUNCTION RAILWAY.

FRANCIS GILES, Esq., Civil Engineer.

This line commences on the north side of Hat House Road, near the Unicorn Gate, Portsea, and passes  $5\frac{1}{2}$  chains to the right of Old Dock Mill, 9 chains to the left of the Poor House at Kingston; thence passing through Rudmore, 3 chains to the left of Stamshaw Farm, 15 chains to the right of Lower Stamshaw Farm, 16 chains to the left of Hilsea, crossing Hilsea Fortification; thence curving within 11 chains of Wymering Church on the right, 3 chains to the right of Palsgrove, 14 chains to the right of Porchester; thence 5 chains to the right of East Cowes, 8 chains to the right of Cain's Hall Park; thence crossing Fareham Bridge diagonally, passing across Peak-lane, Quay-lane, and Blind-lane, at Fareham, 12 chains to the left of the New Church, 19 chains to the left of Blackbrook, crossing Blackbrook-lane,  $15\frac{1}{2}$  chains to the left of Blackbrook House, 11 chains to the left of Fareham Park, 23 chains to the right of Segenworth, 23 chains to the right of Park Farm; thence crossing Hill Coppice, 13 chains to the left of Whitely Farm; thence through Cager's Green, and Eyra's Down, 16 chains to the right of BurrIDGE Farm, 5 chains to the left of Botley Farm, 22 chains to the left of Botley turnpike-road, and at the same distance to the right of Edge End Toll-bar, 14 chains to the left of Botley Grange, 1 chain to the left of Wildern Cross; thence 7 chains to the right of Moor Green,  $2\frac{1}{2}$  chains to the left of Candy's, crossing the Itchen Canal, 13 chains to the left of the Lock House; thence 14 chains to the right of North Stoneham Farm, and joining the London and Southampton Railway, in the parish of North Stoneham, at a point where the proposed Wilts and Hants Railway is intended to commence.



CURVES.

There is a curve in the parish of Fareham, of 46 chains' radius.

GRADIENTS, &c.

Datum—Two Feet below the top of the Curtain at the Hilsea Lines, at the point of crossing.

| Distance from<br>Terminus at<br>Portsea. |         | Length of<br>each Plane |      | Gra-<br>dient. | Inclina-<br>tion. | Ascending or<br>Descending. | Locations.                                                                                            |
|------------------------------------------|---------|-------------------------|------|----------------|-------------------|-----------------------------|-------------------------------------------------------------------------------------------------------|
| Miles.                                   | Chains. | Ms.                     | Chs. | Feet.          |                   |                             |                                                                                                       |
| 2                                        | 34      | 2                       | 34   | 2.98           | 1 in 1766         | Descending                  | Fareham.                                                                                              |
| 3                                        | 53¼     | 1                       | 19¼  | 21.03          | 1 in 251          | Ascending                   |                                                                                                       |
| 7                                        | 37½     | 3                       | 64¼  |                |                   | Level                       |                                                                                                       |
| 9                                        | 54      | 2                       | 16½  | 21.29          | 1 in 248          | Ascending                   |                                                                                                       |
| 10                                       | 20      | 0                       | 46   |                |                   | Level                       | Summit.<br>Near Bursledon Ri-<br>ver, or Tideway<br>Navigation.                                       |
| 10                                       | 62      | 0                       | 42   | 19.06          | 1 in 277          | Ascending                   |                                                                                                       |
| 13                                       | 3½      | 2                       | 21½  | 21.20          | 1 in 249          | Descending                  |                                                                                                       |
| 13                                       | 64¼     | 0                       | 60¾  |                |                   | Level                       | Northam Bridge.                                                                                       |
| 14                                       | 54      | 0                       | 69¾  | 14.91          | 1 in 354          | Ascending                   |                                                                                                       |
| 15                                       | 70      | 1                       | 16   | 21.72          | 1 in 243          | Ascending                   | Near Itchen Canal.<br>Junction with Lon-<br>don and Southamp-<br>ton Railway, near<br>North Stoneham. |
| 18                                       | 9½      | 2                       | 19½  | 20.95          | 1 in 252          | Descending                  |                                                                                                       |
| 18                                       | 55¾     | 0                       | 46¼  |                |                   | Level                       |                                                                                                       |

There is a viaduct proposed over Bursledon River, 891 feet in length, and 40 feet high, in the parish of Droxford.

PRINCIPAL EARTHWORKS.

| Description.    | Length. |      | Greatest height<br>or depth. |  | Average height<br>or depth. |  | Locations.              |
|-----------------|---------|------|------------------------------|--|-----------------------------|--|-------------------------|
|                 | Ms.     | Chs. | Feet.                        |  | Feet.                       |  |                         |
| Cutting . . . . | 1       | 53   | 21                           |  | 13                          |  | Fareham.                |
| Embankment      | 1       | 40   | 40                           |  | 16                          |  | Fareham Town.           |
| Cutting . . . . | 1       | 00   | 37                           |  | 30                          |  | Fareham.                |
| Embankment      | 0       | 36   | 67                           |  | 53                          |  | Fareham and Titchfield. |
| Cutting . . . . | 1       | 60   | 62                           |  | 24                          |  | South Stoneham.         |
| Embankment      | 0       | 74   | 34                           |  | 27                          |  | South Stoneham.         |



## CROSSINGS OF ROADS, &amp;c.

The crossings, according to the Section lodged in the Private Bill Office, consist of six turnpike-roads, three to be passed over and three under; twelve highways and parish-roads, seven over and five under; eleven occupation-roads, seven over and four under; two brooks, streams, &c., and seven level crossings. The Itchen Canal to be passed under 13 feet below the rails' top surface. The Titchfield River to be passed 67 feet, the Itchen 29, and the Bursledon River 41 feet 6 inches below the rails' top surface. The tide navigation at Portsbridge to be passed by a swivel-bridge. The tideway at Portsmouth Harbour is also proposed to be crossed by the railway.

## REMARKS.

The whole length of this line is 18 miles  $55\frac{3}{4}$  chains, and is arranged in five level planes, whose collective length is 5 miles  $57\frac{1}{4}$  chains; and eight inclined planes, with gradients varying from 21.72 feet per mile, or 1 in 243, to 2.98 feet in a mile, or 1 in 1766.

The steepest plane is 1 mile 16 chains long, and inclines at the rate of 1 in 243. The gradients may, therefore, be considered tolerably favorable.

There is one curve under three-quarters of a mile' radius.

The principal earthworks are the Fareham Town embankment, and the South Stoneham cutting.

There are thirty-three bridges required for roads, rivers, canals, &c., and two culverts for streams, &c. The clear height allowed for arches under and over the railway is 14 feet 6 inches, allowing 3 feet 6 inches for the thickness of arch and ballasting, &c., in each case.



## PRESTON AND WYRE RAILWAY.

## PROPOSED DIVERSION.

GEORGE LANDMANN, Esq., Civil Engineer.

This deviation commences in the Parish of Poulton and Township of Hardhorn, and passes between the original Parliamentary line and Todesty Farm, at 6 chains from the latter, and joins the former at the road from Weeton to Mythorp. The whole length of this diversion is 2 miles  $77\frac{1}{4}$  chains, inclining at the rate of 1 in 480, or 11 feet per mile.

The road from Preece Hall to Todesty is 8 feet above, that from Weeton to Mythorp 20 feet 3 inches, and one occupation road 15 feet, above the top surface of rails.

The principal part of this diverted line is to be embanked to an extent of  $2\frac{1}{4}$  miles, and of an average height of 15 feet.

In point of direction this is superior to the original Parliamentary line.

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SAINT GEORGE'S HARBOUR RAILWAY.

This line commences in the parish of Llandidno, Denbighshire, near Great Ormes Head, in Llandidno Bay, and proceeds within half a mile of Little Ormes Head, skirting the coast in the parish of Llanhos; thence to Aberhod, and within 6 chains of Minydon, passing about 27 chains from Llandulas, close to the Battery House, in the parish of Abergele, within 4 chains to the left of Pensam, across Rhydlam Marsh; thence crossing Rhyl Drain near Pont y Cut, 10 chains to the left of Maes-gwylim, again crossing Rhyl Drain in the parish of Dyserth, 27 chains to the left of Moleden, 6 chains to the



left of Nant, 5 chains to the right of Uffer, and within 12 chains of the Life Boat House ; thence curving through the old Warren, and skirting the river Dee, in Mostyn and Bychton Townships ; thence 7 chains to the left of the Holywell Gas Works, through the town of Flint, crossing the Main Street, Johnson's-lane, and three other streets ; thence again skirting the river Dee, in Northop parish, and passing 11 chains to the right of Hawarden Castle Inn, at Lower King's Ferry ; thence close to Cop House, still skirting the river Dee, 3 chains to the left of the Poor House, in the parish of Saint Mary on the Hill, 2 chains to the left of the Toll Gate near New Bridge, over the Dee ; thence crossing the same river, in the parish of Saint Mary on the Hill, Chester, and keeping through the parishes of Saint Oswald and Christleton, 16 chains to the left of the Black Dog Inn, in the parish of Waverton, 19 chains to the right of Golden Nook Bridge, over the Ellesmere Canal, 5 chains to the right of Crow's Nest, 13 chains to the left of Bird's, 6 chains to the right of Beeston Hall ; thence through the parishes of Bunbury, Acton, and Nantwich, and continuing to the Grand Junction Railway at Crewe, at the meeting of the turnpike road from Nantwich to Manchester.

The branch line leaves the main near New Bridge, passes within 3 chains of Hoole-lane Bridge and Tarvin Bridge, over the Ellesmere Canal ; thence curving through the parishes of Oswald and Christleton, proceeds to the proposed terminus in the latter.

There is a curve in this branch of 31 chains' radius, near Hoole-lane Bridge.



GRADIENTS, &c.

Datum—Low Water, Spring Tides.

| Distance from<br>Great Ormes<br>Head. |                  | Length of<br>each Plane |                  | Gra-<br>dient. | Inclina-<br>tion. | Ascending or<br>Descending. | Locations.                                                       |
|---------------------------------------|------------------|-------------------------|------------------|----------------|-------------------|-----------------------------|------------------------------------------------------------------|
| Miles.                                | Chains.          | Ms.                     | Chs.             | Feet.          |                   |                             |                                                                  |
| 1                                     | 17               | 1                       | 17               | 8.25           | 1 in 640          | Descending                  | To end of Tunnel.<br>Tunnel 1782 feet long,<br>and 18 feet high. |
| 2                                     | 41               | 1                       | 24               | 11.55          | 1 in 457          | Ascending                   |                                                                  |
| 2                                     | 67 $\frac{3}{4}$ | 0                       | 26 $\frac{3}{4}$ |                |                   | Level                       |                                                                  |
| 4                                     | 67               | 1                       | 79 $\frac{1}{4}$ | 7.54           | 1 in 700          | Descending                  | Tunnel under Penman<br>Rhos Hill.<br>Tunnel.                     |
| 7                                     | 35 $\frac{1}{2}$ | 2                       | 48 $\frac{1}{2}$ | 3.83           | 1 in 1376         | Ascending                   |                                                                  |
| 7                                     | 52               |                         | 16 $\frac{1}{2}$ |                |                   | Level                       |                                                                  |
| 10                                    |                  | 2                       | 28               | 5.10           | 1 in 1034         | Descending                  |                                                                  |
| 35                                    |                  | 25                      | 00               |                |                   | Level                       |                                                                  |
| 40                                    | 03 $\frac{1}{2}$ | 5                       | 03 $\frac{1}{2}$ | 2.97           | 1 in 1775         | Ascending                   |                                                                  |
| 44                                    | 58 $\frac{1}{2}$ | 4                       | 55               |                |                   | Level                       | Parish Road to Bunbury.<br>Road to Nantwich.                     |
| 50                                    |                  | 5                       | 21 $\frac{1}{2}$ | 12.72          | 1 in 415          | Ascending                   |                                                                  |
| 55                                    |                  | 5                       | 00               | 10.            | 1 in 528          | Ascending                   |                                                                  |
| 56                                    | 35               | 1                       | 35               | 10.43          | 1 in 506          | Ascending                   | Grand Junction Railway                                           |
| 59                                    | 20               | 2                       | 65               |                |                   | Level                       |                                                                  |
| 62                                    | 22 $\frac{1}{2}$ | 3                       | 2 $\frac{1}{2}$  | 9.90           | 1 in 533          | Descending                  |                                                                  |
| 65                                    | 10               | 2                       | 67 $\frac{1}{2}$ | 7.04           | 1 in 750          | Ascending                   |                                                                  |

PRINCIPAL EARTHWORKS.

| Description.    | Length. |      | Greatest height<br>or depth. |     | Average height<br>or depth. |    | Locations.                   |
|-----------------|---------|------|------------------------------|-----|-----------------------------|----|------------------------------|
|                 | Ms.     | Chs. | Feet.                        |     | Feet.                       |    |                              |
| Cutting . . . . |         | 46   | ....                         | 150 | .....                       | 48 | ... Ty Gwyn.                 |
| Cutting . . . . |         | 56   | ....                         |     | .....                       | 44 | ... Little Ormes Head.       |
| Cutting . . . . | 1       | 20   | ...                          |     | .....                       | 38 | ... By Penman Rhos.          |
| Cutting . . . . |         | 60   | ....                         |     | .....                       | 40 | ... Near Brown's-lane.       |
| Cutting . . . . | 4       | 00   | ....                         |     | .....                       | 12 | ... Between 46 and 51 Miles. |
| Embankment      | 2       | 60   | ....                         | 48  | .....                       | 28 | ... Brockhole-lane.          |
| Cutting.....    | 1       | 10   | ....                         |     | .....                       | 36 | ... Beeston Hall.            |

BRANCH.

|                 |   |    |    |  |    |  |                      |
|-----------------|---|----|----|--|----|--|----------------------|
| Embankment      | 1 | 00 | 44 |  | 28 |  | River Dee.           |
| Cutting . . . . | 1 | 40 |    |  | 18 |  | Contiguous to above. |

CROSSINGS OF ROADS, &c.

The crossings, according to the Section lodged in the office of the Clerk of the Peace at Chester, consist of five turnpike-roads ; seventy-one highways, parish roads, and streets, &c. ;



thirty-one occupation roads, one canal, five tramways, thirty-five brooks, streams, &c., and three river crossings, which consist of the Weaver, the Dee, which is 44 feet, and the Clwyd Foryd, which is 20 feet 6 inches below the rails.

#### REMARKS.

The whole length of this line is 65 miles 10 chains, and is arranged in five level planes, whose collective length is 33 miles  $3\frac{1}{4}$  chains, and eleven inclined planes, with gradients varying from 12·72 feet per mile, or 1 in 415, to 2·97 feet in a mile, or 1 in 1775. The gradients, therefore, are very favorable.

There is one curve under three-quarters of a mile' radius.

The whole length of tunnelling in the main line is  $1\frac{1}{2}$  miles and 198 yards.

The principal earthworks are the River Dee embankment, and that of Brockhole-lane; and the cuttings of Ty Gwyn, Little Ormes Head, Penman Rhos, Brown's-lane, and Beeston Hall.

There are one hundred and sixteen bridges required for roads, rivers, canals, &c., and thirty-five bridges and culverts for streams, &c.

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## SALISBURY, ROMSEY, AND SOUTHAMPTON RAILWAY.

F. TWYNAM, Esq., Civil Engineer.

This line leaves the proposed Salisbury, Exeter, and Falmouth Railway at Milford, and proceeds curving through the Liberty of Clarendon Park, passes one chain to the left of Dog Kennel Farm; thence through the parishes of Alderbury and Whaddon, 15 chains to the right of Alderbury Church, crosses the road from Salisbury to Southampton, passes 9 chains to the left of West Grimstead Village, across Grimstead Common Field, 8 chains to the right of West Dean; thence by East Dean, and



Lockerley Green, 4 chains to the right of the Church, crossing the road to Romsey, and the road from Salisbury and Lockerley ; thence through Awbridge, in the parish of Michelmersh, 25 chains to the right of the Duke's Head Inn, Stanbridge, passing through the parish of Romsey,  $4\frac{1}{2}$  chains to the right of the turnpike-road to Winchester, 7 chains to the left of Grove Place, in the parish of Nutshalling ; thence curving through the parish of Millbrook, and recurving to its intended termination in St. John's parish, Southampton.

CURVES.

The curves under three quarters of a mile' radius are, one at Milford, of 22 chains ; a second at Alderbury, of 40 chains ; and a third at Salisbury, of the same radius.

GRADIENTS, &c.

| Distance from<br>the proposed<br>Salisbury, Exe-<br>ter, & Falmouth<br>Railway. |                 | Length of<br>each plane. |                 | Gra-<br>dient. | Inclina-<br>tion. | Ascending or<br>Descending. | Locations.                                   |
|---------------------------------------------------------------------------------|-----------------|--------------------------|-----------------|----------------|-------------------|-----------------------------|----------------------------------------------|
| Miles.                                                                          | Chains.         | Ms.                      | Chs.            | Feet.          |                   |                             |                                              |
|                                                                                 | 40              |                          | 40              |                |                   | Level                       |                                              |
| 2                                                                               | $59\frac{1}{2}$ | 2                        | $19\frac{1}{2}$ | 7·02           | 1 in 752          | Ascending                   |                                              |
| 3                                                                               | $11\frac{1}{2}$ | 0                        | 32              |                |                   | Level                       |                                              |
| 15                                                                              | 00              | 11                       | $68\frac{1}{2}$ | 11·            | 1 in 480          | Descending                  | Romsey.                                      |
| 20                                                                              | 00              | 5                        | 00              | 9·11           | 1 in 580          | Descending                  |                                              |
| 23                                                                              |                 | 3                        | 00              |                |                   | Level                       | Quay near the New<br>Pier, Southamp-<br>ton. |

PRINCIPAL EARTHWORKS.

| Description. | Length. |      | Greatest height<br>or depth.<br>Feet. | Average height<br>or depth.<br>Feet. | Locations.                         |
|--------------|---------|------|---------------------------------------|--------------------------------------|------------------------------------|
|              | Ms.     | Chs. |                                       |                                      |                                    |
| Cutting..... | 50      | .... | 73                                    | .... 45                              | Laverstock.                        |
| Cutting..... | 2       | 10   | .... 64                               | .... 24                              | Alderbury and West Grim-<br>stead. |
| Cutting .... | 1       | 33   | .... 31                               | .... 20                              | West Dean.                         |
| Embankment   | 1       | 54   | .... 32                               | .... 17                              | Lockerley.                         |
| Embankment   | 3       | 40   | .... 20                               | .... 9                               | Awbridge and Romsey.               |
| Cutting..... | 2       | 40   | .... $47\frac{1}{2}$                  | .... 18                              | Naisling.                          |
| Embankment   | 2       | 30   | .... 19                               | .... 14                              | Southampton.                       |



## CROSSINGS OF ROADS, &amp;c.

The crossings, according to the Section lodged in the Private Bill Office, consist of six turnpike-roads, five to be passed over the railway, and one under; twenty highways and parish-roads, eleven over and nine under; thirty-one occupation-roads, sixteen over and fifteen under; eighteen foot-paths, fifteen brooks, streams, &c., and two level crossings. The Old Canal to be passed six times under the railway, and the Andover and Redbridge Canal to be altered, by removing the lock near the point of crossing, and carrying the railway over the lower pool.

The rivers to be passed under the railway are the Dunbridge and the Test.

## REMARKS.

The whole length of this line is 23 miles, and is arranged in three level planes, whose collective length is 3 miles 72 chains, and three inclined planes, with gradients varying from 11 feet per mile, or 1 in 480, to 7.02 feet in a mile, or 1 in 752. The gradients therefore are exceedingly favorable.

The curves under three quarters of a mile' radius are three in number.

The principal earthworks are the cuttings of Laverstock, Alderbury, West Dean, and Naisling, and the Lockerley, Romsey, and Southampton embankments.

There are eighty-three bridges required in this line for roads, rivers, canals, &c., and fifteen bridges and culverts, for streams, &c. The clear height allowed for turnpike-road arches under and over the railway, is 14 feet 6 inches, allowing 3 feet 6 inches for the thickness of arch and ballasting, &c.



## SHEFFIELD, ASHTON-UNDER-LYNE, AND MANCHESTER RAILWAY.

CHARLES VIGNOLES, Esq., Civil Engineer.

This line commences at Store-street, Manchester, and crosses Travis-street, the Ashton-road, and the river Medlock, passes close on the north of the Pottery in Ardwick, running parallel with Corn Brook, till it crosses the Stockport Canal; thence gently curving northward to the road to Andenshaw, about a quarter of a mile from the Toll Bar; thence south of the Ashton Canal, and approaching close to the towing-path on the east side of the road to Horley Hill; thence crossing the river Tame, and the Peak Forest Canal, and curving in a south-easterly direction to Dewsnap Colliery, passing to Newton Green and south of Godley Hill, within 9 chains of Brookfold; thence crossing the woods in Slattersley and Mottram, proceeds to Broadbottom, and passing north of Upper Gamesley, curves northward between Shaw and Mousley, and midway between Hadfield and Padfield, and within 12 chains of the latter; thence to Deepclough, running parallel with the river Etherow, and approaching it within 4 chains in Padfield Township; thence continuing to the south side of Torside, and within 5 chains thereof, and crossing the road twice north of the Old Factory, passing to the south of Woodhead, and within a quarter of a mile of the same, and again crossing the river Etherow at three places, and running close on the north side of the same; thence passing the high ground in the Township of Tintwistle, by means of a tunnel; thence



crossing the road within 3 chains of Danford Bridge, near the east end of the tunnel, and the River Dun at four several places, within 5 chains of Saughley Bridge, passing by Rainhall; thence south of Bull House Hall, and north of Penistone, south of Oxspring Mills, crossing the river Dun at Blackmoor, and passing north of Outhwaite House, and close to the same river near Old Mill; thence to Wood End, and curving through Wharncliffe Wood, on the east side of the same river, passing close to Oughtibridge Hall; thence curving through Beely Wood, within two chains of the Toll Bar near Wadsley Bridge; thence passing to Wardsend, and through Crain Wood and Old Park Wood, crossing Harvest-lane, the Sheffield and Wakefield Road, Rock-street, Fitzallan-street, running north of Stanley-street, and crossing the Wicker within  $1\frac{1}{2}$  chains of Stanley-street; thence North of Willey-street, and crossing the river Dane  $6\frac{1}{2}$  chains from Blonk-street, and continuing to the intended station in the Cattle Market, at Effingham-street, Sheffield.

The Branch to Ashton-under-Lyne and Staley Bridge leaves the main line on the west side of Guide Bridge, crosses the Ashton Canal, and running near the road to Ashton, crosses Welbeck-street, Port-lane, Bentinck-street, Cavendish-street, and passing close on the south side of Park Parade, crosses the road from Dukinfield, and within 4 chains of the Canal Bridge; thence curving to Staley Bridge, crosses the river Tame close to the Cotton Mills, and traversing Henry-street, terminates near the Canal Bridge, in the parish of Stockport.

#### CURVES.

The curves under three-quarters of a mile' radius are, one at the east side of Ashton, of half a mile, one of the same radius at Staley Bridge, and a third at the western part of Oxspring Township.



## GRADIENTS, &amp;c.

Datum—Level of the Sea at Low Water

| Distance from Store-street, Manchester. |         | Length of each plane. |      | Gradient. | Inclination. | Ascending or Descending. | Locations.                                  |
|-----------------------------------------|---------|-----------------------|------|-----------|--------------|--------------------------|---------------------------------------------|
| Miles.                                  | Chains. | Ms.                   | Chs. | Feet.     |              |                          |                                             |
|                                         | 53½     |                       | 53½  | 8·97      | 1 in 588     | Ascending                |                                             |
| 2                                       | 53½     | 2                     | 0    | 30·       | 1 in 176     | Ascending                | To Stockport Canal.                         |
| 4                                       | 74      | 2                     | 20½  | 41·90     | 1 in 126     | Ascending                | To Junction with Branch.                    |
| 5                                       | 40      | 0                     | 46   | 23·46     | 1 in 225     | Ascending                |                                             |
| 9                                       | 14      | 3                     | 54   | 37·79     | 1 in 139     | Ascending                |                                             |
| 11                                      | 14      | 2                     | 0    | 26·53     | 1 in 199     | Ascending                |                                             |
| 18                                      | 74      | 7                     | 60   | 44·       | 1 in 120     | Ascending                | Entrance of Tunnel, Township of Tintwistle. |
| 22                                      | 26½     | 3                     | 32½  | 20·       | 1 in 264     | Ascending                | Summit.                                     |
| 40                                      | 31¾     | 18                    | 5¼   | 42·24     | 1 in 125     | Descending               | East side of Tunnel.                        |
| 40                                      | 66      |                       | 34¼  |           |              | Level                    | Terminus at Effingham-street, Sheffield.    |

The branch to Staley Bridge is 2 miles 44½ chains long, and has one level plane 36 chains long, and four inclined planes, with inclinations varying from 1 in 100 to 1 in 767. The worst plane is but for a short length.

There is a tunnel proposed near Dead Edge, 2 miles 76 chains long, 30 feet high, and 420 feet below the surface of ground.

## PRINCIPAL EARTHWORKS.—MAIN LINE.

| Description. | Length. |      | Greatest height or depth. |       | Average height or depth. |       | Locations.               |
|--------------|---------|------|---------------------------|-------|--------------------------|-------|--------------------------|
|              | Ms.     | Chs. |                           | Feet. |                          | Feet. |                          |
| Embankment   | 2       | 40   | ....                      | 48    | ....                     | 18    | Leaving Manchester.      |
| Cutting..... | 2       | 40   | ....                      | 36    | ....                     | 20    | Adjoining the above.     |
| Cutting..... |         | 40   | ....                      | 63    | ....                     | 36    | About 9 miles.           |
| Embankment   |         | 40   | ....                      | 140   | ....                     | 40    | About 10 miles.          |
| Cutting..... |         | 40   | ....                      |       | ....                     | 40    | Glossop Turnpike-road.   |
| Cutting..... |         | 50   | ....                      | 102   | ....                     | 42    | Between 30 and 31 miles. |
| Cutting .... |         | 40   | ....                      | 82    | ....                     | 44    | About 35 miles.          |
| Cutting..... |         |      | ....                      | 112   | ....                     | 50    | Old Park Wood.           |



## CROSSINGS OF ROADS, &amp;c.

The crossings of the main line, according to the Section lodged at the office of the Clerk of the Peace at Wakefield, consist of sixteen turnpike-roads, seven to be passed over the railway and nine under; forty highways and parish roads, twenty over and twenty under; twenty-seven occupation roads, eighteen over and nine under; five footpaths; thirty-eight brooks, streams, cloughs, &c.

The Stockport Canal to be passed over the railway at an elevation of 20 feet, and the Peak-Forest Canal at 21 feet under the rails' top surface. The rivers to be passed over the railway are, the Etherow at 8 feet, and the Dun three several times, at 22, 14, and 10 feet above the rails, in each case respectively. The rivers to be passed under the railway are, the Medlock at 55, the Tame at 50, the Etherow at 142, and again at 12 feet; the Dun three times at 16, 65, and 36 feet 6 inches severally below the rails, and one other river crossing.

## REMARKS.

This line is 40 miles 66 chains in length, and consists of one level plane, whose length is  $34\frac{1}{4}$  chains, and nine inclined planes, with gradients ranging from 44 feet per mile, or 1 in 120, to 8.97 feet in a mile, or 1 in 588.

The steepest plane is 3 miles  $32\frac{1}{2}$  chains long, inclines at the rate of 1 in 120, and will require an assistant engine.

There are three curves under three-quarters of a mile' radius.

The tunnelling of the main line amounts in length to 5192 yards.

The principal earthworks are, the Manchester embankment, and that about 10 miles, the cutting contiguous to the former, the Glossop Road cutting, and three others, including that at Old Park Wood.

The bridges required for roads, &c., in the main line, are



ninety-seven, the aqueducts five, and the bridges and culverts for brooks, streams, &c., thirty-eight in number.

The clear height allowed for arches over and under the railway, is 14 feet 6 inches, allowing 3 feet 6 inches for the thickness of arch, ballasting, &c., in each case.

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## SOUTH EASTERN RAILWAY.

### PROPOSED EXTENSION AND DEVIATIONS.

WILLIAM CUBITT, ESQ. F.R.S. M.R.I.A. &c. Civil Engineer.

#### LONDON EXTENSION AND GODSTONE DEVIATION.

[The London Extension has already been described under the title of London and Penge Railway, at page 140.]

From Penge Common this line proceeds to Addiscombe Park; thence continuing through Croydon parish to Riddlesdown, passing under the high ground by a tunnel; thence curving and recurving through Catterham, Godstone, Andridge, Oxted and Lymfield parishes, and terminating at the road to Stafford's Wood Common, near Willwood Farm House.

#### OXTED DEVIATION.

The Oxted deviation leaves the Godstone line in Warlingham parish, and proceeds through that parish, passes to the left of Marden Park by means of a tunnel, within 2 chains of Woldingham Church on the left; thence to Oxted, across Hurst Green and six chains to the right of Itchinwood Common; thence in a direct line through Westerham and Edenbridge parishes, to its junction with the original Parliamentary line at Brooksham Pound, in the parish of Edenbridge.



PROPOSED DEVIATION BETWEEN BOW BEACH AND  
TUDLEY.

This divergence commences at the road from Edenbridge; thence passing to the left of New Barn, in Penshurst parish, 8 chains to the right of White Posts Farm; thence across the northern portion of Penshurst Park, (where two other deviations are also shewn, called the northern deviation and the central deviation); thence continuing within 4 chains and to the right of Haysden, passing to Brook-street Farm, 12 chains to the right of Tunbridge National Schools, 3 chains to the left of Relphs, 8 chains to the left of Brook Farm; thence skirting Postern Paddock on the left, and joining the original line, 5 chains to the north of the road from Tunbridge to Tudley.

DOVOR DEVIATION.

Commencing at Cheesman's Head, in the parish of St. Mary the Virgin, Dovor, this line is proposed to be carried along Shakspeare's Cliff, and to the left of Lydden Spout Station House; thence to the right of Pelter Brig,  $2\frac{3}{4}$  chains to the right of the Martello Tower, in Folkestone Township; thence curving to within  $8\frac{1}{2}$  chains of Broad Mead on the left, and passing between End Brook and Cheriton-street; thence in a direct line to its junction with the main, in the parish of Newington, 10 miles and 13 chains from the Dovor terminus.

GRADIENTS, &c.

The London extension and Godstone deviation line together are 23 miles 1 furlong in length, and consist of one level plane, half-a-mile long, and two inclined planes, with gradients of 20 feet in a mile, the first ascending to the entrance of the proposed tunnel, and the second descending to near Willwood Farm House.



The Oxted deviation line is 9 miles 67 chains long, and has one plane ascending to entrance of long tunnel, at the rate of 1 in 264, or 20 feet in a mile, and the other descending to the original line at road from Edenbridge.

The Bow Beach and Tudley deviation is 7 miles 74 chains in length, with one plane descending to the Medway, at the rate of 1 in 475, or 11.11 feet per mile, and a second, also descending to the original line at road from Tudley to Hadlow, at the rate of 1 in 1141, or 4.62 feet in a mile. The Dovor deviation is 10 miles 13 chains long, having inclinations from 1 in 100, or 52.80 feet in a mile, to 1 in 264, or 20 feet in a mile, arranged in three planes, the first descending to Archcliff Fort, and the other two ascending to the original line.

There are also two deviations shewn at Penshurst Park; the northern is 1 mile  $7\frac{3}{4}$  chains long, and rises to the River Medway, at the rate of 1 in 487, or 10.84 feet per mile, and the central deviation from the same place, inclines at the rate of 1 in 480, or 11 feet per mile.

#### TUNNELS.

In the Godstone deviation, the proposed tunnel in Sanderstead parish is 2422 feet long, 30 feet high, and 178 feet below summit of ground.

In the Oxted deviation, the tunnel proposed near Woldingham Church is 11497 feet long, 30 feet high, 490 feet below the summit, and 120 feet below the lowest part of surface.

In the Dovor deviation, the proposed tunnel by Martello Tower No. 1, is 1080 feet long, 30 feet high, and 72 feet below surface; that in Hougham, 810 feet long, 30 feet high, and 103 feet below surface; a third at Shakspear's Cliff, 2904 feet long, of the same height, and 202 feet below surface.

The railway for two miles in Hougham parish to be carried along the face of the cliffs by means of side-cuttings, and occasional short tunnels and galleries.



## PRINCIPAL EARTHWORKS.

## GODSTONE DEVIATION.

| Description. | Length. |      | Greatest height<br>or depth. |      | Average height<br>or depth. |       | Locations.               |                |
|--------------|---------|------|------------------------------|------|-----------------------------|-------|--------------------------|----------------|
|              | Ms.     | Chs. | Feet.                        |      | Feet.                       |       |                          |                |
| Embankment   | 1       | 65   | ....                         | 40   | .....                       | 24    | ... Croydon.             |                |
| Cutting..... |         | 76   | ...                          | 100  | .....                       | 35    | ... Sanderstead.         |                |
| Cutting      | ....    | 1    | 67                           | ...  | 146                         | ..... | 50                       | ... Catterham. |
| Cutting      | ....    | 1    | 30                           | ...  | 102                         | ..... | 48                       | ... Godstone.  |
| Cutting      | ....    |      | 68                           | .... | 80                          | ..... | 40                       | ... Tandridge. |
| Embankment   | 1       | 68   | ....                         | 52   | .....                       | 36    | ... Tandridge and Oxted. |                |

## OXTED DEVIATION.

|              |   |    |      |     |       |    |                          |
|--------------|---|----|------|-----|-------|----|--------------------------|
| Cutting .... | 1 | 20 | ...  | 100 | ..... | 42 | Walsingham and Godstone. |
| Cutting .... | 1 | 12 | .... | 98  | ..... | 45 | By Tunnel.               |
| Cutting .... | 1 | 30 | .... | 60  | ..... | 27 | Oxted and Lympfield.     |

## DOYOR DEVIATION.

|              |  |    |     |     |       |    |                        |
|--------------|--|----|-----|-----|-------|----|------------------------|
| Cutting .... |  | 69 | ... | 106 | ..... | 40 | Capel le Ferne Parish. |
|--------------|--|----|-----|-----|-------|----|------------------------|

## CROSSINGS OF ROADS, &amp;c.

The crossings of the Godstone deviation, according to the Section lodged in the Private Bill Office, consist of three turnpike-roads to be passed over the railway ; twenty-one highways and parish-roads, eight over and thirteen under ; four occupation roads, two over and two under ; one foot-path, four brooks, streams, &c. The Croydon Canal to be twice passed over the railway, and twice under, in the latter case, 21 feet below the rails' top surface. The Croydon and Godstone Turnpike-road, to be thrice diverted.

In the Oxted deviation line, there are two turnpike-roads to be passed over the railway ; nine highways and parish-roads, seven over and two under ; five occupation-roads, four over and one under ; and six streams, &c.

In the diversion from Bow Beach to Tudley, the crossings consist of three turnpike-roads, two to be passed over the railway and one under ; eight highways and parish-roads,



four over and four under ; twelve occupation-roads, eight over and four under ; and six brooks, streams, &c.

The railway to pass over the River Medway, at an elevation of 25 feet above the water's surface.

The Dovor diversion presents two turnpike-roads to be passed under the railway ; ten highways and parish roads, four over and six under ; and two streams, &c.

As the Greenwich Railway is proposed to form one of the grand outlets from the metropolis to the south-eastern portion of the kingdom, and also to the Continent, and as much information respecting it was, during the last Session of Parliament, sought for, we have considered it sufficiently interesting to insert the following particulars:—

#### GREENWICH RAILWAY.

The original survey for the London and Greenwich Railway, was made under the direction of Mr. Giles ; the whole has, however, been executed from the design, and under the superintendence of Colonel Landmann.

This measure was introduced for the consideration of Parliament, in the session of 1833, and received the Royal assent on the 17th of May, of the same year.

The commencement of this railway is at Joiner's-street, Southwark, near London Bridge, and is approached by a sloped carriage-road, and two well paved foot-paths, together about 50 feet in width, and about 60 yards in length ; the station is entered by iron gates, and is about 400 feet in length, and 60 feet in width ; at the station there are four lines of way, which diverge into two lines, at a distance of about 130 yards from the entrance. Leaving the station, the railway viaduct crosses the Maize, Bermondsey-street, Dog and Bear-yard, Butler's Buildings, Church-street, Russell-street, Wellington-street, the Neckenger, Grange-road, Blue Anchor-lane, Corbett's-lane, the Surrey Canal, Coney Hall-lane, and Loving Edward's-lane, and continues to the station at High-street, Deptford ; it thence curves to London-street, Greenwich, crossing Church-street, and the River Ravensbourne, or Deptford Creek. The station at Deptford is sufficiently commodious for the traffic of that place, and is approached by an inclined carriage-way, from the High-street, and two flights of steps for foot passengers ; the distance from London Bridge to Greenwich by the turnpike-road, is  $5\frac{1}{2}$  miles, and by the railway, when finished, it will be  $3\frac{3}{4}$  miles ; thus effecting a saving in distance of  $1\frac{1}{4}$  miles, from London Bridge to Greenwich.



The construction of the railway viaduct is almost wholly of brickwork, the arches for the most part being of uniform span, and varying in height with the levels of the ground; of these, eight hundred and four are finished between the London Terminus and Deptford Creek, and fourteen unfinished,\* including that for Deptford High-street; the arches of uniform span in this length, are 741 in number, each being 18 feet wide, and semicircular, and having piers, four bricks or three feet in thickness, which is just one sixth of the span; the arches are 18 inches in thickness, consisting of  $1\frac{1}{2}$  brick, and a four-inch rim; the foundations are built with regular footings; the depths to which these are carried, vary with the nature of the subsoil, and the whole rests upon a mass of concrete; the remaining openings vary in span, from 6 feet to 30 feet, the springings of which, for the most part, range with those of the 18 feet arches.

The oblique, or skew arches, are twenty-seven in number; those most worthy of notice, are the crossings of Bermondsey-street, the Neckenger, the Grange-road, Blue Anchor-road, and the Surrey Canal; the crossing of Bermondsey-street, which is really well executed, consists of three openings, one for the carriage-way, 17 feet 6 inches wide, and 19 feet high to the soffit; and two foot-paths, 6 feet 6 inches wide, and of the same height; the whole is effected at an angle of  $38^\circ$ , and is constructed of six cast iron ribs, extending over the carriage-way, and two foot-ways, for a length of about 58 feet; these are supported on twelve cast iron columns of the Roman Doric order, 16 feet in height, and standing upon a continuous plinth, for each set of columns, above each line of which, an iron tie runs from one side of the bridge to the other; the whole is further strengthened by horizontal and vertical crosses, the latter supporting on their upper flanches, stout Yorkshire landings; on these landings are bedded transverse wooden plates, to which are secured longitudinal sleepers of oak, about 12 inches square, connected together by transverse iron ties; upon these sleepers are bedded the rails, through the medium of cast iron chairs spiked down to the sleepers. The crossings of the Neckenger and Grange-road, are very similar in design, but of different dimensions, in consequence of the different angle of obliquity. The Neckenger-road has a clear opening left for the carriage-way, of 26 feet, and 6 feet 6 inches for each of the foot-ways; each foot-path is separated from the carriage-way, by a line of Grecian Doric cast iron columns, four in number, and a solid pier at either end.

The extreme width of the viaduct is 26 feet, and the clear width about 23 feet; there are two lines of way from the Southwark to the Deptford station; they are fixed at the usual guage of 4 feet  $8\frac{1}{2}$  inches; the side spaces next the parapet are about 3 feet in width. The rails are of the common form of edge rail, about  $2\frac{1}{4}$  inches wide on the top surface,  $4\frac{1}{4}$  inches in depth, and 1 inch

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\* Our last survey of this line was on the 9th of December, 1836, since which time it has been opened to the public from the Southwark Station.



thick at bottom, in 15 feet lengths, seated in cast iron pedestals, 3 feet apart, and secured thereto by wrought wedges : these chairs are set on rough granite blocks, containing each about 4 cubic feet, between the top surface of which and the chairs are introduced pieces of felt, a plan now almost universally adopted ; the chairs are secured to the blocks by iron spikes, about 4 inches in length, driven into oak plugs inserted in perforations made in the blocks for their reception.

The metallic cement with which the tops of the arches are rendered, has unfortunately not had the desired effect, for in wet weather, the surface water finds its way through the arches to a considerable extent, so as to render the railway arcade almost impassable. Had well tempered clay been introduced over all the arches and spandrils, this might have been entirely prevented. It is well known, that this custom is practised by all London bricklayers, with regard to vaults built under the street pavements.

Great difficulties have presented themselves in the foundations, owing to the nature of the subsoil, which, to a considerable extent, was found to consist of peat of a blackish colour. Some of the arches have already been rebuilt, and it is to be feared, that several others will also require the same precaution to be taken with them.

The whole viaduct is furnished with gas-lights, the effect of which on a dark night is peculiarly striking. The original design for this work consisted of a series of segmental arches, each of 27 feet span, and rising about 9 feet, supported on piers 3 feet 9 inches in thickness, or little more than one-seventh of the span. Fortunately, however, this design was abandoned before any of the work was commenced.

It is much to be regretted, that more attention has not been paid to this erection, (especially its foundations and arches,) which might, if well executed, and formed of ample dimensions, have presented one of the finest structures of modern times.

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## SOUTH-EASTERN, BRIGHTON, LEWES, AND NEWHAVEN RAILWAY.

There are two lines proposed, one to leave the present line of the South-Eastern Railway at Oxted, the other to join the intended South-Eastern Deviation, near Godstone Church : the former passes to Broadham Green ; thence through Tandridge parish, passing to Blindley Heath, in Godstone parish ; thence passing through the parish of Horne, and to the left of Frogwood Heath ; thence through East Grinstead parish,



passing the high ground in West Hoatley parish, by means of a tunnel; thence through Lindfield, crossing the Ouze upper navigation, and Charley North Common, through the parishes of Westmeston and Charley; thence through the parish of St. John, under the Castle of Lewes, and curving, with two short tunnels, to Falmer, near which the lines to Lewes and Newhaven diverge; thence proceeding to its termination, a quarter of a mile west of the church of St. Peter and St. Mary's parishes, the main line continuing through Patcham parish, and leaving Preston about a furlong on the right; thence running nearly parallel with the London Road, and terminating on the north side of Carlton Hill, Brighton, about a quarter of a mile from the Pavilion, and about 38 chains from St. Peter's Church.

The Newhaven Line passes through Kingston, 8 chains to the east of the church; thence through Iford, Rodmill, and South Ease parishes, passing through Peddington, and continuing to the intended station at Newhaven.

GRADIENTS, &c.

From proposed South-eastern Railway at Godstone to Brighton.

Datum—Trinity High Water Level.

| Distance from<br>the South-<br>Eastern line<br>near Godstone. |         | Length of<br>each plane. |      | Gra-<br>dient. | Inclina-<br>tion. | Ascending or<br>Descending. | Locations.                                                                           |
|---------------------------------------------------------------|---------|--------------------------|------|----------------|-------------------|-----------------------------|--------------------------------------------------------------------------------------|
| Miles.                                                        | Chains. | Ms.                      | Chs. | Feet.          |                   |                             |                                                                                      |
| 6                                                             | 25      | 6                        | 25   | 20·            | 1 in 264          | Descending                  | At this point the levels<br>of line from Oxted<br>would join those<br>from Godstone. |
| 9                                                             | 78      | 3                        | 53   | 20·            | 1 in 264          | Ascending                   |                                                                                      |
| 11                                                            | 38      | 1                        | 40   |                |                   | Level                       |                                                                                      |
| 20                                                            | 18      | 8                        | 60   | 20·            | 1 in 264          | Descending                  |                                                                                      |
| 21                                                            | 18      | 1                        |      |                |                   | Level                       | Tunnel at Falmer.                                                                    |
| 25                                                            | 75      | 4                        | 57   | 20·            | 1 in 264          | Ascending                   |                                                                                      |
| 28                                                            | 28      | 2                        | 33   |                |                   | Level                       |                                                                                      |
| 31                                                            | 58      | 3                        | 30   | 21·55          | 1 in 245          | Descending                  |                                                                                      |
| 32                                                            | 3       |                          | 25   |                |                   | Level                       | Nearly opposite the<br>upper end of Rich-<br>mond-road, Bright-<br>ton.              |



## GRADIENTS, &amp;c. OF BRANCHES.

The length of the proposed line from the present South-Eastern Railway to the proposed line from Godstone, is 6 miles 34 chains in length, consisting of two planes, with gradients of 20 feet per mile each.

The Branch to Lewes is 2 miles 67 chains in length, and has two planes, one level for 27 chains, and the remainder falling at the rate of 1 in 228, or 23·15 feet per mile.

The Newhaven Branch has also two planes, the first falling at the rate of 1 in 203, or 26·01 feet per mile, and the other level, for a length of 31 chains; the whole being 6 miles 41 chains in length.

## TUNNELS.

| Nos.    | Length.<br>Yards. | Height.<br>Feet. | Depth below<br>Surface.<br>Feet. | Inclination.   | Locations.    |
|---------|-------------------|------------------|----------------------------------|----------------|---------------|
| 1 ..... | 640 .....         | 30 .....         | .....                            | 1 in 264 ..... | West Hoatley. |
| 2 ..... | 880 .....         | 30 .....         | 200 .....                        | 1 in 264 ..... | Mount Harry.  |
| 3 ..... | 200 .....         | 30 .....         | 126 .....                        | Level. ....    |               |
| 4 ..... | 200 .....         | 30 .....         | 160 .....                        | Level. ....    |               |
| 5 ..... | 570 .....         | 30 .....         | 100 ...                          | 1 in 264 ..... | Falmer.       |

## PRINCIPAL EARTHWORKS.

| Description.  | Length<br>Ms. Chs. | Greatest height<br>or depth.<br>Feet. Ins. | Average height<br>or depth.<br>Feet. | Locations.              |
|---------------|--------------------|--------------------------------------------|--------------------------------------|-------------------------|
| Cutting ..... | 77 .....           | .....                                      | 55 ...                               | Godstone.               |
| Embankment 1  | 00 .....           | 77 3 .....                                 | 55 ...                               | Godstone and Horne.     |
| Cutting.....  | 2 25 .....         | 75 .....                                   | 44 ...                               | Horne & East Grinstead. |
| Cutting.....  | 2 00 ...           | 150 .....                                  | 55 ...                               | West Hoatley.           |
| Embankment 1  | 60 .....           | 65 .....                                   | 31 ...                               | Westmeston.             |
| Cutting.....  | 59 .....           | 138 .....                                  | 58 ...                               | Lewes and Falmer.       |
| Cutting.....  | 1 11 .....         | 72 9 .....                                 | 42 ...                               | Lindfield.              |
| Embankment 1  | 34 .....           | 79 4 .....                                 | 40 ...                               | Lindfield.              |
| Embankment 1  | 35 .....           | 85 .....                                   | 46 ...                               | Lewes Branch.           |

## CROSSINGS OF ROADS, &amp;c.

According to the section lodged in the Private Bill Office, the crossings of roads, &c. in main line from Godstone to



Brighton, consist of seven turnpike-roads, three to be passed over the railway and four under; twenty-six highways and parish-roads, fifteen over and eleven under; nineteen occupation-roads, ten over and nine under; one footpath; thirty-two brooks, streams, &c.

The Ouse Navigation to be passed under, at 80 feet 2 inches below the rails; and the River Eden also to be passed under the Railway.

In the Branch to Lewes there are two turnpike-roads, one over and one under; three highways and parish-roads, one over and two under; and three occupation-roads under.

The Newhaven Branch presents fifteen highways, parish and other roads, nine over and six under; and eight occupation-roads, one over and seven under.

#### REMARKS.

The whole length of the main line is 32 miles 3 chains, and is arranged in four level planes, whose collective length is 5 miles 18 chains, and five inclined planes, with gradients of 20 feet per mile, or 1 in 264, except one plane, which falls at the rate of 1 in 245, or 21.55 feet per mile.

The whole length of tunnelling is 2490 yards.

The principal earthworks are, the cuttings of Godstone, Horne, and East Grinstead, West Hoatley, Lewes, and Lindfield; and the embankments of Godstone, Westmeston, Lindfield, and that in the Lewes Branch.

There are fifty-five bridges required for the main line for roads, rivers, canals, &c, and thirty-two bridges and culverts for streams, &c. The clear height allowed for turnpike-road arches under the railway is 15 feet 6 inches, and for arches over the railway, 16 feet, allowing four feet for the thickness of arch and ballasting, &c., in each case.

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## SOUTH-EASTERN, CANTERBURY, RAMSGATE, AND SANDWICH RAILWAY.

BEWICKE BLACKBURN, Esq., Engineer.

This line is intended to leave the South-Eastern Railway at Ashford, and pass, with a slightly-curved line, through the parishes of Willesborough, Kennington, and Boughton-Aluph; thence passing to the right of Bitting, through Godmersham parish, and curving through the parish of Chilham; thence crossing parts of the parishes of St. Dunstan, Westgate, and St. Stephen, effecting a junction, by a branch, 16 chains long, with the Canterbury and Whitstable Railway, about 15 chains to the left of the depôt at Canterbury; the main line, leaving Canterbury, passes through Sturry parish, 16 chains to the right of Westbere Church; thence through Stodmarsh and Preston parishes, 11 chains to the right of Stourmouth Church, beyond which the branch goes off to the right to Sandwich; the main line continuing through the parishes of Monkton and Minster, 24 chains to the left of Ebbs Fleet, 5 chains to the right of Cliff's end, crossing a portion of Pegwell Bay; thence skirting the sea-shore to the Royal Harbour of Ramsgate. The Sandwich branch passes 6 chains to the left of Sparrow Castle, 8 chains to the right of Guston, 4 chains to the right of Fleet; thence terminating on the right bank of the River Stour, at Sandwich.

### CURVES.

The curves under three-quarters of a mile' radius are, one at Ashford, of 48 chains, and one in Sturry parish, of about the same radius.



GRADIENTS, &c.

Datum—Top of Ramsgate Pier.

| Distance from Ashford. |         | Length of each Plane |      | Gra-dient. | Inclina-tion. | Ascending or descending. | Locations.                                 |
|------------------------|---------|----------------------|------|------------|---------------|--------------------------|--------------------------------------------|
| Miles.                 | Chains. | Ms.                  | Chs. | Feet.      |               |                          |                                            |
| 0                      | 59      | 0                    | 59   |            |               | Level                    | Turnpike-road from Ashford to Hythe.       |
| 1                      | 45½     | 0                    | 66½  | 15·95      | 1 in 331      | Descending               | Near River Stour.                          |
| 3                      | 5       | 1                    | 39½  |            |               | Level                    |                                            |
| 5                      | 67½     | 2                    | 62½  | 9·26       | 1 in 570      | Descending               | Near same.                                 |
| 8                      | 25½     | 2                    | 38   |            |               | Level                    | Tunnel in this length.                     |
| 9                      | 45½     | 1                    | 20   | 16·        | 1 in 330      | Descending               | Between River Stour and Shalmsford-st.     |
| 9                      | 65      | 0                    | 19½  |            |               | Level                    | Near same.                                 |
| 10                     | 35      | 0                    | 50   | 16·        | 1 in 330      | Descending               | Turnpike-road from Ashford to Canterbury.  |
| 10                     | 73      | 0                    | 38   |            |               | Level.                   | St. Dunstan's-street. Canterbury.          |
| 12                     | 3½      | 1                    | 10½  | 8·84       | 1 in 597      | Descending               |                                            |
| 13                     | 44¾     | 1                    | 41¼  |            |               | Level                    |                                            |
| 16                     | 30      | 2                    | 65¼  | 11·73      | 1 in 450      | Descending               | Turnpike-road from Canterbury to Ramsgate. |
| 25                     | 4       | 8                    | 54   |            |               | Level                    | Ramsgate Western Quay.                     |
| 26                     | 00      | 0                    | 76   | 6·31       | 1 in 836      | Descending.              |                                            |
| 28                     | 73      | 2                    | 73   |            |               | Level                    |                                            |

The Sandwich Branch is 4 miles 28½ chains long, and level.

There is a tunnel proposed in Godmersham parish, 247½ yards long, 30 feet high, and 62 feet below the surface of ground.

PRINCIPAL EARTHWORKS.

| Description. | Length. |      | Greatest height or depth. |  | Average height or depth. |  | Locations.                      |
|--------------|---------|------|---------------------------|--|--------------------------|--|---------------------------------|
|              | Ms.     | Chs. | Feet.                     |  | Feet.                    |  |                                 |
| Embankment   | 1       | 6    | 22                        |  | 16                       |  | River Stour.                    |
| Cutting      | 0       | 22   | 50                        |  | 27                       |  | Chilham.                        |
| Embankment   | 1       | 26   | 23                        |  | 15                       |  | River Stour, Chilham parish.    |
| Cutting      | 1       | 20   | 42                        |  | 18                       |  | Chartham.                       |
| Embankment   | 2       | 00   | 23                        |  | 17                       |  | Canterbury.                     |
| Embankment   | 4       | 00   |                           |  | 7                        |  | Preston, Ash, Monkton, Minster. |
| Embankment   | 1       | 00   |                           |  | 14                       |  | Pegwell Bay.                    |



## CROSSINGS OF ROADS, &amp;c.

The crossings, according to the Section lodged in the Private Bill Office, consist of seven turnpike-roads, five to be passed over the railway and two under; twenty-nine highways and parish and other roads, twenty over and nine under.

The Canterbury and Whitstable Railway to be passed 15 feet under the rails' top surface.

The railway to pass over the River Stour nine times, at elevations above the water's surface of from 16 to 25 feet. The Little Stour to be also passed under; and the railway to pass over a portion of Pegwell Bay, at 15 feet above the water's surface.

## REMARKS.

The whole length of this line is 28 miles 73 chains, and is arranged in eight level planes, whose collective length is 18 miles  $42\frac{1}{4}$  chains; and seven inclined planes, with gradients varying from 16 feet per mile, or 1 in 330, to 6.31 feet in a mile, or 1 in 836. The gradients, therefore, are very favorable.

The curves under three-quarters of a mile' radius are two in number.

The whole length of tunnelling in the main line is  $247\frac{1}{2}$  yards.

The principal earthworks are the River Stour embankments, and those of Canterbury and Pegwell Bay, and the cuttings in Chilham and Chartham parishes.

There are forty-seven bridges required for roads, rivers, &c. The clear height allowed for turnpike-road arches under the railway is 17 feet, and for arches over the railway 15 feet, allowing 4 feet for the thickness of arch and ballasting, &c. in each case.

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SOUTH-EASTERN AND MAIDSTONE  
RAILWAY.

W. A. PROVIS, Esq., Civil Engineer.

This line leaves the South-Eastern Railway by Postern Park, in Maidstone parish, and proceeds 5 chains to the right of Upper Postern Farm,  $2\frac{1}{2}$  chains to the left of Dairy Farm, 5 chains to the right of Barn-street, 4 chains to the right of Bullen's Farm; thence to the left of Chidley Cross, 4 chains to the left of Burr's Oak,  $1\frac{1}{2}$  chains to the left of the Brick Kilns, 10 chains to the right of Nettlested; thence through Teston, 10 chains to the left of Teston Bridge, crossing the Medway, and running nearly parallel with that river for about  $1\frac{1}{2}$  miles, and within 7 chains of Barming Bridge on the right; thence curving to within  $7\frac{1}{2}$  chains of Fant on the left, passing close on the right of Bower Lodge, and terminating in a plot of ground on the west side of the Medway at Maidstone.

## GRADIENTS, &amp;c.

This line is 11 miles  $57\frac{1}{2}$  chains in length, and consists of two level and three inclined planes, the former amounting in length to 5 miles 40 chains, and the latter ranging in point of inclination from 1 in 432 to 1 in 528; the gradients, therefore, are very favorable.

The chief earthworks are the Capel and Hadlow embankment,  $2\frac{1}{2}$  miles long, and averaging 14 feet in height; that of the River Medway, 51 chains long, and averaging 20 feet in height; and the Maidstone cutting,  $1\frac{3}{4}$  miles long, and averaging 35 feet in depth.



## CROSSINGS OF ROADS, &amp;c.

The crossings, according to the section lodged in the Private Bill Office, consist of two turnpike-roads to be passed over the railway; thirteen highways and parish roads, ten over and three under; twelve occupation roads, nine over and three under; twenty footpaths; twelve brooks, streams, &c. and four level crossings. The River Medway to be thrice passed under the railway, at depths below the rails' top surface once of 12 and twice of 32 feet.

## REMARKS.

There are fifty bridges required for roads, rivers, &c. and twelve bridges and culverts for streams, &c. The clear height allowed for road arches over the railway, is 16 feet, allowing 4 feet for the thickness of arch, ballasting, &c.

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SOUTH MIDLAND COUNTIES' RAILWAY.

FRANCIS GILES, Esq., Civil Engineer.

This line commences at the London and Birmingham Railway, 10 chains from the Courteenhall and Blisworth-road, with a curve of three quarters of a mile' radius; passes 24 chains west of Collingtree Church, crossing the road from Towcester to Northampton, and the River Nen Navigation, at Far Cotton; thence along Abbott's Meadow, 6 chains to the east of St. Andrew's Mill, 5 chains east of King's-thorpe Church, across the road to Welford, within 15 chains of Boughton Mill, (on the west,) 4 chains to the west of Pitsford, 6 chains west of Weston's Farm, 35 chains west of Bexworth Church, 45 chains west of Lamport Inn, and 8 chains to the east of Oxenden; thence crosses Kibworth, within 15 chains



west of the Church, and joins the Midland Counties' Railway, at the intersection of the road from Wigston to Aylestone.

#### BRANCH TO LEICESTER.

This branch passes in its course within  $1\frac{1}{2}$  chains to the east of Swan Mill, crosses the Union Canal, and the Old Soar; thence crossing Braunston Gate, within  $1\frac{1}{2}$  chains of the Old Soar, joins the Leicester and Swannington Railway, half a mile from the Leicester Station.

#### BRANCH TO STAMFORD.

This branch leaves the intended South Midland Railway at Lubenham, near Market Harborough, 10 chains north of Bowden Wharf, crosses the River Welland, in the parish of Ashley, and again at four different places, in the parishes of Medborne and Ashley, passes on the north side, and close to Drayton, and south of Easton Close; thence on the north of Caldecot, within 7 chains of its Church; thence north of Thorpe and Morcot, and passing through South Luffenham, and  $5\frac{1}{2}$  chains north of the Church; thence north of Ketton and Tinwell, continues to its intended terminus near Scotgate, Stamford.

#### CURVES.

The curves under three-quarters of a mile' radius are, one at Newton Harcourt, of 35 chains; and a second, near road from Welford to Leicester, of half a mile' radius.

In the Stamford branch, there are two curves under three-quarters of a mile, one of 23 chains' and the other of 20 chains' radius, both contiguous to the proposed South Midland Railway.



## GRADIENTS, &amp;c. OF MAIN LINE.

| Distance from Junction with London and Birmingham Railway. |                  | Length of each plane. |                  | Gradient. | Inclination. | Ascending or Descending. | Locations.                                |
|------------------------------------------------------------|------------------|-----------------------|------------------|-----------|--------------|--------------------------|-------------------------------------------|
| Miles                                                      | Chains.          | Ms.                   | Chs.             | Feet.     |              |                          |                                           |
| 5                                                          |                  | 5                     |                  | 20·       | 1 in 264     | Descending               | To end of Tunnel.<br>Tunnel in this plane |
| 7                                                          | 40               | 2                     | 40               | 14·       | 1 in 377     | Ascending                |                                           |
| 8                                                          |                  | 0                     | 40               |           |              | Level                    |                                           |
| 16                                                         | 40               | 8                     | 40               | 14·       | 1 in 377     | Ascending                |                                           |
| 16                                                         | 60               | 0                     | 20               |           |              | Level                    |                                           |
| 22                                                         | 40               | 5                     | 60               | 13·93     | 1 in 379     | Descending               |                                           |
| 25                                                         | 35               | 2                     | 75               |           |              | Level                    | Midland Counties'<br>Railway.             |
| 27                                                         | 20               | 1                     | 65               | 14·79     | 1 in 357     | Ascending                |                                           |
| 27                                                         | 60               | 0                     | 40               |           |              | Level                    |                                           |
| 33                                                         | 61 $\frac{3}{4}$ | 6                     | 01 $\frac{3}{4}$ | 14·       | 1 in 377     | Descending               |                                           |

There is one tunnel proposed under the road from Harrington to Kilmarsh, 1320 feet long.

## GRADIENTS, &amp;c.

## STAMFORD BRANCH.

| Distance from Junction with Main Line. |         | Length of each Plane |      | Gradient. | Inclination. | Ascending or Descending. | Locations. |
|----------------------------------------|---------|----------------------|------|-----------|--------------|--------------------------|------------|
| Miles.                                 | Chains. | Ms.                  | Chs. | Feet.     |              |                          |            |
| 6                                      | 00      | 6                    | 00   | 18·02     | 1 in 293     | Descending               | Stamford.  |
| 6                                      | 37      | 0                    | 37   |           |              | Level                    |            |
| 7                                      | 17      | 0                    | 60   | 18·02     | 1 in 293     | Ascending                |            |
| 7                                      | 48      | 0                    | 31   |           |              | Level                    |            |
| 10                                     | 49      | 3                    | 01   | 1·16      | 1 in 4544    | Descending               |            |
| 13                                     | 00      | 2                    | 31   |           |              | Level                    |            |
| 15                                     | 40      | 2                    | 40   | 2·20      | 1 in 2400    | Ascending                |            |
| 15                                     | 70      | 0                    | 30   |           |              | Level                    |            |
| 18                                     | 70      | 3                    | 00   | 48·44     | 1 in 109     | Ascending                |            |
| 19                                     | 40      | 0                    | 50   |           |              | Level                    |            |
| 20                                     | 73      | 1                    | 33   | 18·27     | 1 in 289     | Descending               |            |
| 21                                     | 47      | 0                    | 54   |           |              | Level                    |            |
| 22                                     | 42      | 0                    | 75   | 18·14     | 1 in 291     | Ascending                |            |
| 23                                     | 29      | 0                    | 67   |           |              | Level                    |            |

The branch to the Leicester and Swannington Railway is 3 miles 25 chains long, and descends to that way, at the rate of 1 in 264, or 20 feet per mile.



## PRINCIPAL EARTHWORKS.

| Description. | Length. |      | Greatest height<br>or depth. |      | Average height<br>or depth. |      | Locations                |
|--------------|---------|------|------------------------------|------|-----------------------------|------|--------------------------|
|              | Ms.     | Chs. | Feet.                        | Ins. | Feet.                       | Ins. |                          |
| Embankment 1 | 20      | .... | 70                           |      | 33                          | ...  | Beyond 1 mile.           |
| Embankment 2 | 20      | ...  | 69                           | 6    | 38                          | ...  | Northampton.             |
| Embankment 1 | 40      | .... | 62                           |      | 45                          | ...  | Between 8 and 11 miles.  |
| Embankment 2 | 00      | .... | 48                           | 3    | 29                          | ...  | Between 11 and 13 miles. |
| Embankment 1 | 20      | .... | 46                           |      | 32                          | ...  | Between 13 and 15 miles. |
| Embankment 1 | 40      | .... | 72                           |      | 58                          | ...  | Near Harboro'.           |
| Embankment 1 | 60      | .... | 45                           | 6    | 32                          | ...  | Between 24 and 27 miles. |
| Cutting .... | 60      | .... | 65                           |      | 42                          | ...  | Near 3 miles.            |
| Cutting .... | 1       | 20   | ....                         | 47   | 6                           | ...  | Between 6 and 8 miles.   |
| Cutting .... | 1       | 40   | ....                         | 66   |                             | ...  | Kilmarsh.                |
| Cutting ...  | 1       | 40   | ....                         | 66   | 6                           | ...  | Oxenden.                 |
| Cutting .... | 1       | 20   | ....                         | 63   |                             | ...  | Harboro'.                |
| Cutting .... | 1       | 30   | ....                         | 64   | 6                           | ...  | Kibworth.                |

## LEICESTER BRANCH.

|              |    |      |    |   |    |     |                          |
|--------------|----|------|----|---|----|-----|--------------------------|
| Embankment 2 | 70 | ...  | 39 | 0 | 21 | ... |                          |
| Cutting ...  | 30 | .... |    |   | 13 | ... | Junction with main line. |

## STAMFORD BRANCH.

|              |    |      |      |    |    |    |                               |
|--------------|----|------|------|----|----|----|-------------------------------|
| Cutting .... | 58 | .... | 70   |    | 49 |    | Weston.                       |
| Cutting .... | 1  | 40   | .... | 55 | 3  | 21 | 6 Morcot.                     |
| Embankment 1 | 60 | .... | 46   | 0  | 40 | 0  | Between land 4 miles.         |
| Embankment 2 | 40 | .... | 25   | 6  | 19 | 6  | From Weston to River Welland. |

## CROSSINGS OF ROADS, &amp;c.

The crossings of the main line, according to the section lodged with the Clerk of the Peace for Leicester, consist of four turnpike-roads, two to be passed over the railway and two under; thirty-six highways and parish roads, fourteen over and twenty-two under; two occupation roads over; one footpath; sixteen brooks, streams, &c. and two level crossings.

The Grand Junction Canal to be passed 67 feet 6 inches below rails, and the Union Canal 20 feet above. The Rivers



Nen and Welland to be passed under the railway, the former at 63 and the latter at 72 feet below the rails' top surface.

The crossings of the Leicester branch consist of one turnpike-road under, five highways and parish roads under; the Union Canal 25 feet below the rails, and one crossing of the River Soar.

In the Stamford branch there are three turnpike-roads over; twenty-two highways and parish roads, ten over and twelve under; ten brooks, streams, &c. and eight level crossings. The Union Canal to be passed over 38 feet 6 inches above the rails. The River Welland to be passed under the railway six times; and there is another river crossing.

#### REMARKS.

The whole length of the main line is 33 miles  $61\frac{3}{4}$  chains, and is arranged in four level planes, whose collective length is 4 miles 15 chains, and six inclined planes, with gradients varying from 20 feet per mile, or 1 in 264, to 13·93 feet in a mile, or 1 in 379.

The Stamford branch is 23 miles 29 chains long, and consists of fourteen planes, of which seven are level, whose collective length is 5 miles 60 chains, and the remaining ones varying in inclination from 1 in 109 to 1 in 4544. The steepest plane is 3 miles in length, and having a gradient of 48·44 feet per mile, will require an assistant engine.

The curves under three-quarters of a mile' radius are four in number.

The whole length of tunnelling in the main line is 440 yards, or a quarter of a mile.

Among the principal earthworks may be mentioned the Northampton and Harboro' embankments, and the Oxenden and Harboro' cuttings.

There are one hundred and two bridges required for the main line, for roads, rivers, canals, &c. and twenty-six bridges and culverts for streams, &c. The clear height allowed for



turnpike-road arches, both over and under the railway, is 14 feet 6 inches, allowing 3 feet 6 inches for the thickness of arch and ballasting, &c.

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## SOUTH WESTERN RAILWAY.

GEO. STEPHENSON, ESQ., Engineer.

This line, leaving the Bristol and Exeter Railway near Bathpool, in the parish of West Monkton, proceeds across the river Tone, through the parish of Thorn-Falcon, 7 chains to the left of Henlade House, 2 chains to the left of Ash Farm, through the parish of West Ash, across the road from West Hatch to Mare Elm, 4 chains to the right of Hatch-Beauchamp, and 4 chains to the right of Beer Crocombe, across the New Canal, 3 chains to the left of Badbury, across the river Isle, through the parish of Isle Brewers, 10 chains to the right of Golden Hill, through Barrington, and Shepton-Beauchamp parishes; through the parish of Kingsbury, in the Tithings of East, West, and Middle Lambrook, across the road from East Lambrook to South Petherton, and that from South Petherton to Martock, crossing the river Perrett, through Bower-Henton, in the parish of Martock, across the road from Ilminster to Ilchester, 17 chains to the right of Cart-gate Inn, through West Stoke, 6 chains to the left of East Stoke, through the parish of Montacute, 17 chains to the left of Montacute House, curving through Odcombe Parish, 3 chains to the right of Lufton, across the road from Crewkerne to Yeovil; thence by a tunnel under the road from Brympton to Yeovil, within 5 chains to the right of Alvington, curving through Yeovil; thence entering the county of Dorset, within 13 chains to the right of Clifton House, through the parishes of Clifton and Thornton, across the road from Bradford-Abbas to Beer-Hacket, curving 5 chains to the left of Beer-Hacket, and across



Knighton and Long-Burton Commons, within 11 chains to the left of Butterwick Farm, through the parish of Bishop's Caundle, crossing the river Lidden, and again crossing the same river, enters the county of Dorset; thence 7 chains to the left of Rowton Mill, 2 chains to the left of the river Lidden, 7 chains to the left of Smith's Farm, crossing the river Stour to the right of Marnhull-street, passing through the parish of Fifehead Magdalen, 7 chains to the left of Magestone, crossing the river Lidden; thence to the right of Gillingham, and entering the county of Wilts, passing to the right of Voters Springs, 6 chains to the right of Semwick Bridge, within 3 chains to the right of East Hatch, 5 chains to the right of Wickwood Farm, 15 chains to the left of Hazelton, 12 chains to the right of Tisbury, close by Tisbury Mill, within 3 chains to the right of Chicksgrove Mill, 8 chains to the right of Chicksgrove, 4 chains to the right of Ley Barn, in the parish of Teffont Ewyas, 3 chains to the right of Dalens, across the road from Catherine Ford to Dinton, 6 chains to the right of Baverstock, 9 chains to the left of the French Horn Inn, through the parishes of Baverstock and Barford, within 3 chains, and to the left of the River Nadder, across the road from Groveley, through the Tithings of Quidhampton, and Bemerton, in the parish of Fugglestone St. Peter; thence parallel with the road from Warminster, across the River Devizes and the branch of the Avon, 27 chains to the left of Salisbury, through the parishes of Milford, Laverstock, and Ford, 10 chains to the right of Ashley Hill Farm, in the liberty or royalty of Clarendon Park; thence through High Wood and Church Way Wood, through the parish of West Dean, across the road from West Dean to West Tytherly, through the parish of Broughton, crossing the road from Romsey to Wallop, through the parish of King's Sombourne, 25 chains to the right of Horsebridge, whence the Winchester branch diverges: the main line continuing across the Roman-road from Old Sarum to Winchester, at its junction with the road from Romsey,



25 chains to the right of King's Sombourne, across the road to Ashley, curving through the parishes of Little Sombourne and Upper Sombourne, 15 chains to the right of Rookley House, 10 chains to the right of the junction of the roads from Stockbridge and Crawley at the Rack and Manger Public House, through the parish of Crawley, crossing the road to Crawley within 13 chains to the right of Croft's Farm, 10 chains to the right of Town Down, 18 chains to the left of Littleton, across the road from Andover to Winchester, through the parish of Headbourn-Worthy, 30 chains to the right of New Burn; thence through the parishes of Headbourne-Worthy, and King's Worthy, passing within 17 chains to the left of Hook Pit Farm, and proceeding to its junction with the London and Southampton Railway.

The Winchester branch leaves the main line in the parish of King's Sombourne, passes through the parish of Drayton-Houghton, 10 chains to the left of Park Farm, 12 chains to the left of Hooker's Bottom, through Leckford, crossing Chilbolton Common, within 2 chains of Chilbolton, 2 chains and to the right of South Side Farm, curving through the parish of Tuften, within 3 chains of Tuften; through the parishes of Whitchurch, Freefolk, Laverstock, Overton, Aske, Dean, Church-Oakley, Monk-Sherborne, and joining the London and Southampton Railway in the parish of Worting.



## GRADIENTS, &amp;c.—MAIN LINE.

Datum—Level of Trinity High Water London.

| Distance from Junction with Bristol and Exeter Railway. |         | Length of each plane. |      | Gradient. | Inclination. |     | Ascending or descending. | Locations.                                   |
|---------------------------------------------------------|---------|-----------------------|------|-----------|--------------|-----|--------------------------|----------------------------------------------|
| Miles.                                                  | Chains. | Ms.                   | Chs. | Feet.     |              |     |                          |                                              |
| 2                                                       | 20      | 2                     | 20   | 22·       | 1 in         | 240 | Ascending                | Near Road from Hatch Beauchamp.              |
| 4                                                       | 46      | 2                     | 26   | 16·14     | 1 in         | 327 | Ascending                |                                              |
| 8                                                       | 65      | 4                     | 19   | 16·04     | 1 in         | 329 | Descending               |                                              |
| 11                                                      | 75      | 3                     | 10   |           |              |     | Level                    | Near Turnpike-road from Crewkerne to Yeovil. |
| 18                                                      | 24½     | 6                     | 29½  | 16·19     | 1 in         | 326 | Ascending                |                                              |
| 19                                                      | 44      | 1                     | 19½  |           |              |     | Level                    | Road from Fury Knaps to Preston.             |
| 22                                                      | 24      | 2                     | 60   | 8·36      | 1 in         | 631 | Descending               | Near Road by Clifton House.                  |
| 28                                                      | 63½     | 6                     | 39½  | 16·04     | 1 in         | 329 | Ascending                |                                              |
| 30                                                      | 23½     | 1                     | 40   |           |              |     | Level                    |                                              |
| 35                                                      | 43      | 5                     | 19½  | 11·45     | 1 in         | 461 | Descending               |                                              |
| 38                                                      | 42½     | 2                     | 79½  | 14·70     | 1 in         | 359 | Ascending                |                                              |
| 41                                                      | 32      | 2                     | 69½  | 7·67      | 1 in         | 688 | Ascending                |                                              |
| 44                                                      | 15½     | 2                     | 63½  | 16·14     | 1 in         | 327 | Ascending                | Near Division of Counties.                   |
| 47                                                      | 38      | 3                     | 22½  | 22·27     | 1 in         | 237 | Ascending                | Near Tisbury.                                |
| 50                                                      | 60      | 3                     | 22   | 15·90     | 1 in         | 332 | Descending               |                                              |
| 52                                                      | 65      | 2                     | 05   | 6·78      | 1 in         | 778 | Descending               | Near Chick's Grove.                          |
| 56                                                      | 29      | 3                     | 44   | 15·80     | 1 in         | 334 | Descending               |                                              |
| 57                                                      | 67      | 1                     | 38   | 6·10      | 1 in         | 865 | Descending               |                                              |
| 60                                                      | 67      | 3                     | 0    | 10·       | 1 in         | 528 | Descending               | Near Wilton.                                 |
| 62                                                      | 13      | 1                     | 26   |           |              |     | Level.                   | Salisbury.                                   |
| 64                                                      | 23½     | 2                     | 10½  | 16·       | 1 in         | 330 | Descending               |                                              |
| 67                                                      | 24      | 3                     | 0½   | 15·30     | 1 in         | 345 | Ascending                | Royalty of Clarendon Park.                   |
| 68                                                      | 1       |                       | 57   |           |              |     | Level.                   |                                              |
| 71                                                      | 51      | 3                     | 50   | 16·29     | 1 in         | 324 | Descending               |                                              |
| 73                                                      | 67      | 2                     | 16   |           |              |     | Level                    |                                              |
| 76                                                      | 69      | 3                     | 2    | 13·89     | 1 in         | 380 | Descending               |                                              |
| 78                                                      | 48      | 1                     | 59   | 16·14     | 1 in         | 327 | Ascending                | Near King's Sombourne.                       |
| 84                                                      | 35      | 5                     | 67   | 20·22     | 1 in         | 261 | Ascending                | Road to North Wood.                          |
| 85                                                      | 67½     | 1                     | 32½  | 19·20     | 1 in         | 275 | Descending               | To London and Southampton Railway.           |
| 87                                                      | 37      | 1                     | 49½  |           |              |     | Level                    |                                              |

## BRANCH TO NEAR WINCHESTER.

|    |     |   |     |       |      |      |           |                                |
|----|-----|---|-----|-------|------|------|-----------|--------------------------------|
| 78 |     | 1 | 3   |       |      |      | Level     |                                |
| 82 | 78½ | 4 | 78½ | 4·01  | 1 in | 1316 | Ascending |                                |
| 85 | 1   | 2 | 2½  | 9·85  | 1 in | 536  | Ascending |                                |
| 95 |     | 9 | 79  | 16·04 | 1 in | 329  | Ascending |                                |
| 99 | 47  | 4 | 47  | 9·60  | 1 in | 550  | Ascending | Terminus in Parish of Worting. |



## TUNNELS—MAIN LINE.

| Nos.      | Length.<br>Yards. | Height. Below Surface.<br>Feet. | Feet.       | Inclination.     | Locations.                 |
|-----------|-------------------|---------------------------------|-------------|------------------|----------------------------|
| 1 . . . . | 440 . . . .       | 22 . . . .                      | 66 . . . .  | Level . . . .    | Brympton.                  |
| 2 . . . . | 546 . . . .       | 22 . . . .                      | 134 . . . . | 1 in 629 . . . . | Berwick.                   |
| 3 . . . . | 490 . . . .       | 22 . . . .                      | 80 . . . .  | 1 in 629 . . . . | Berwick.                   |
| 4 . . . . | 410 . . . .       | 22 . . . .                      | 72 . . . .  | 1 in 345 . . . . | Clarendon Park<br>Royalty. |

## PRINCIPAL EARTHWORKS.—MAIN LINE.

| Description.    | Length.      | Greatest height<br>or depth. | Average height<br>or depth. | Locations.                                          |
|-----------------|--------------|------------------------------|-----------------------------|-----------------------------------------------------|
|                 | Ms. Chs.     | Feet.                        | Feet.                       |                                                     |
| Cutting . . . . | 1 10 . . . . | 52 . . . . .                 | 32 . . . .                  | Hatch Beauchamp.                                    |
| Embankment 1    | 20 . . . .   | 31 . . . . .                 | 22 . . . .                  | Isle Abbots.                                        |
| Embankment 2    | 00 . . . .   | 20 . . . . .                 | 14 . . . .                  | Pinkington and Barrington.                          |
| Cutting . . . . | 1 00 . . . . | 38 . . . . .                 | 25 . . . .                  | Kingsbury, South Pether-<br>ton, and Beer-Crocombe. |
| Embankment 1    | 20 . . . .   | 35 . . . . .                 | 23 . . . .                  | Isle Abbots and Isle<br>Brewers.                    |
| Embankment 1    | 00 . . . .   | 39 . . . . .                 | 32 . . . .                  | River Perrett.                                      |
| Embankment 1    | 00 . . . .   | 44 . . . . .                 | 30 . . . .                  | Yeovil.                                             |
| Embankment 1    | 70 . . . .   | 38 . . . . .                 | 26 . . . .                  | Clifton and Beer Hacket.                            |
| Cutting . . . . | 1 65 . . . . | 58 . . . . .                 | 36 . . . .                  | Long Burton.                                        |
| Cutting . . . . | 1 00 . . . . | 47 . . . . .                 | 33 . . . .                  | Gillingham.                                         |
| Cutting . . . . | 1 26 . . . . | 46 . . . . .                 | 28 . . . .                  | East Knoyle, West Tisbury.                          |
| Cutting . . . . | 1 60 . . . . | 36 . . . . .                 | 21 . . . .                  | Fugglestone Saint Peter.                            |
| Cutting . . . . | 1 25 . . . . | 40 . . . . .                 | 22 . . . .                  | Alderbury.                                          |
| Embankment 1    | 10 . . . .   | 43 . . . . .                 | 39 . . . .                  | River Test.                                         |
| Cutting . . . . | 1 0 . . . .  | 61 . . . . .                 | 38 . . . .                  | King's Sombourne.                                   |
| Embankment 2    | 40 . . . .   | 42 . . . . .                 | 32 . . . .                  | Upper Sombourne.                                    |

## WINCHESTER BRANCH.

|                 |            |              |            |                   |
|-----------------|------------|--------------|------------|-------------------|
| Embankment 1    | 15 . . . . | 42 . . . . . | 32 . . . . | King's Sombourne. |
| Cutting . . . . | 60 . . . . | 51 . . . . . | 38 . . . . | Barton Stacey.    |
| Embankment 2    | 00 . . . . | 32 . . . . . | 25 . . . . | Long Parish.      |
| Cutting . . . . | 43 . . . . | 57 . . . . . | 34 . . . . | Overton.          |

## CROSSINGS OF ROADS, &amp;c.

The crossings of the main line, according to the Section lodged in the Private Bill Office, consist of twenty-one



turnpike roads, twelve to be passed over the railway and nine under ; eighty-eight highways and parish roads, thirty-three over and fifty-five under ; forty-eight occupation-roads, twenty-four over and twenty-four under ; one foot-path, thirty-six brooks, streams, &c., and one level crossing.

The New Canal to pass at 14, and the Andover Canal at 43 feet below the rails' top surface.

There are fifteen river crossings, including those of the Isle, the Perrett, six crossings of the Lidden, three of the Stour one of the Test, and one of the Avon.

The Stourminster turnpike-road to be diverted, and likewise that from Salisbury to Hindon.

The crossings of the Winchester branch consist of five turnpike-roads, four to be passed over the railway and one under ; thirty-nine highways and parish roads, ten over and twenty-nine under ; sixteen occupation-roads, five over and eleven under ; six brooks, streams, &c., and one level crossing.

The Andover Canal to be passed under at 17 feet below the rails' top surface.

The river Test to be passed at 42 feet under the rails, and there is another river crossing.

The turnpike-road from Stockbridge to Basingstoke to be diverted.

#### REMARKS.

The whole length of the main line is 87 miles 37 chains, and is arranged in seven level planes, whose collective length is 11 miles 58 chains, and twenty-three inclined planes, with gradients varying from 22·27 feet per mile, or 1 in 237, to 6·10 feet in a mile, or 1 in 865.

The steepest plane is that ascending towards Tisbury, at the rate of 1 in 237 or 22·27 feet per mile, for a length of 3 miles 22½ chains.

The western terminal plane is on an ascent from the Bristol and Exeter Railway, having a gradient of 22 feet per mile, and the eastern terminal plane is level.



The steepest plane in the Winchester branch is that inclining at the rate of 1 in 329, or 16·04 feet per mile.

The summit is 47 miles 38 chains from the Bristol and Exeter Railway, and 327 feet above its rails' top surface, and 131 feet above the Southampton Railway at point of junction.

The length of the Winchester branch is 22 miles 50 chains, and consists of one level plane, 1 mile 3 chains in length, and four inclined planes, with gradients varying from 16·04 feet per mile or 1 in 329 to 4·01 feet per mile, or 1 in 1316.

The whole length of tunnelling in the main line is 1886 yards.

The principal earthworks are the Hatch-Beauchamp, the Kingsbury, Levy Burton, Gillingham, East Knoyle, Fugglestone St. Peter, Alderbury, and King's Sombourne cuttings; and the embankments of Isle Abbotts, Pinkington, Isle Brewers, Yeovil, Clifton, River Test, and Upper Sombourne.

There are two hundred and thirty-eight bridges required in the main line and branch, for roads, rivers, canals, &c., and forty-two bridges and culverts for streams, &c. The clear height allowed for turnpike-road arches, over and under the railway, is 16 feet, allowing 4 feet for the thickness of arch and ballasting, &c.

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## STAFFORD AND RUGBY RAILWAY.

JOSEPH LOCKE, Esq., Engineer.

This line commences at the Grand Junction Railway, near Stafford, at a point 25 chains east of Green Bridge, over the River Sowe, and curving south of the mill, runs within seven chains to the left of Forebridge Hall; thence crossing the River Penk and the Staffordshire and Worcestershire Canal, passes on to Milford, and crosses the road to Stafford, a quarter of a mile from the meeting of that and the road to Brackton, the latter road being crossed at about 9 chains distant from the same meeting; thence passing by means of a tunnel, 31 chains long and about twenty-feet high, towards Harpwood Park



Farm, leaving the buildings 4 chains to the left; thence within 5 chains to the left of Oak Edge Park, and by means of arches through the eastern portion of Wolseley Park, 12 chains to the right of Wolseley Hall, 3 chains to the right of Daywell Cottage, crossing the Grand Trunk Canal near Rugeley; thence 9 chains to the left of Rugeley Church, 6 chains to the right of Armitage Church, 25 chains to the right of the Red Lion Inn, in Armitage parish, 3 chains to the left of Brook Farm, 10 chains to the right of Vicar's Coppice, in the parish of Kings Bromley, 5 chains to the right of Curborough, 17 chains to the right of the Toll Bar at Street Hay on the road from Burton-on-Trent to Lichfield; thence crossing the Coventry Canal, 34 chains beyond the crossing of the Burton-on-Trent and Lichfield road, at Street Hay; thence half-a-chain to the right of Fisherwick Lodge Gates, 8 chains to the left of the bridge over the Coventry Canal, at Tamhorn, 30 chains to the right of Cumberford Hall; thence across the main street at Tamworth, 23 chains to the right of the meeting of the Ashby, Wiggington, and Burton turnpike-roads; thence crossing the Birmingham and Derby intended Railway, 10 chains west of the River Anker, and at an angle of  $84^{\circ}$ ,  $7\frac{1}{2}$  chains to the left of the bridge over the Coventry Canal, at Amington,  $1\frac{1}{2}$  chains to the right of Repington Arms Inn, 4 chains to the right of Alvecote Mill, crossing the River Anker in Polesworth parish; thence curving to within 5 chains and to the right of Grendon House, 6 chains to the right of the Red Lion, and 5 chains to the left of Anker Hill, in Sheepy Magna parish, 7 chains to the right of Mythe Farm, 10 chains to the left of Witherley, 13 chains to the left of Kennet, 23 chains to the right of Drayton Barn, crossing Watling-street, in Fenny-Drayton parish, 25 chains to the right of the road to Hurst's Hill; thence passing to the left of the Coventry Canal, in Caldecot parish, nearing it within  $1\frac{1}{4}$  chains in Nuneaton parish and passing across Nuneaton, 6 chains to the right of the buildings of Attleborough Fields, within 3 chains of the Windmill on the road from Lutterworth to Attleborough; thence crossing the Ashby Canal,



and passing within 13 chains and to the right of the Windmill, at Bulkington ; thence within 4 chains and to the right of Shilton Church, 5 chains to the left of Hipsford Mill, 11 chains to the left of Coomb Fields, 3 chains to the left of Stretton Wharf, 19 chains to the right of Easenhall, 4 chains to the left of the Oxford Canal, in Newbold-upon-Avon parish, crossing the same Canal at Newbold and the Old Oxford Canal at Rugby Wharf, and joining the London and Birmingham Railway, 48 chains south-east of Rugby Mill.

There is one curve in this line at the meeting with Grand Junction Railway, near Stafford, of a quarter of a mile' radius.

The Lichfield branch diverges from the main line 37 chains south-east of the road to Lichfield at Curborough, and passes 10 chains to the right of Stowe Church, terminating in Saint Mary's parish, Lichfield. There is a curve in this branch at junction with main line from Curborough, of a quarter of a mile' radius.

## GRADIENTS, &amp;c.

Datum.—Level of the Sea at Low Water.

| Distance from<br>Stafford. |         | Length of<br>each Plane |      | Gra-<br>dient. | Inclina-<br>tion. | Ascending or<br>Descending. | Locations.                                                    |
|----------------------------|---------|-------------------------|------|----------------|-------------------|-----------------------------|---------------------------------------------------------------|
| Miles.                     | Chains. | Ms.                     | Chs. | Feet.          |                   |                             |                                                               |
|                            | 29½     |                         | 29½  | 16·            | 1 in 330          |                             | Turnpike-road from Staf-<br>ford.                             |
| 4                          | 39½     | 4                       | 10   | 13·23          | 1 in 399          | Ascending.                  | Near Turnpike - road,<br>Stafford to Lichfield.               |
| 8                          | 36¾     | 3                       | 77¼  | 13·36          | 1 in 395          | Descending                  | Grand Trunk Canal.                                            |
| 9                          | 36¾     | 1                       | 00   | 10·            | 1 in 528          | Descending                  |                                                               |
| 9                          | 63¾     |                         | 27   |                |                   | Level.                      |                                                               |
| 10                         | 63¾     | 1                       | 00   | 10·            | 1 in 528          | Ascending.                  | Grand Trunk Canal.                                            |
| 14                         | 57      | 3                       | 73¼  |                |                   | Level                       |                                                               |
| 19                         | 58¾     | 5                       | 1¾   | 10·17          | 1 in 519          | Descending                  |                                                               |
| 22                         | 30½     | 2                       | 51¾  | 3·77           | 1 in 1397         | Ascending                   | Near the Birmingham<br>and Derby Junction<br>Railway.         |
| 24                         | 66½     | 2                       | 36   | 10·05          | 1 in 525          | Ascending                   | Near road to Alvecote<br>Mill.                                |
| 30                         | 74½     | 6                       | 08   | 3·27           | 1 in 1610         | Ascending                   |                                                               |
| 37                         | 54      | 6                       | 59½  | 10·58          | 1 in 499          | Ascending                   | Ashby Canal.                                                  |
| 40                         | 53      | 2                       | 79   | 5·02           | 1 in 1051         | Ascending                   |                                                               |
| 42                         | 12¾     | 1                       | 39¾  | 10·03          | 1 in 526          | Descending                  | Old Oxford Canal.                                             |
| 48                         | 25¼     | 6                       | 12½  |                |                   | Level                       |                                                               |
| 49                         | 54      | 1                       | 28¾  | 4·04           | 1 in 1305         | Descending                  | Junction with London<br>and Birmingham Rail-<br>way at Rugby. |



The Lichfield branch is 1 mile  $41\frac{3}{4}$  chains in length, and rises to its intended termination at Lichfield, at the rate of 1 in 334, or 15·80 feet per mile.

#### TUNNELS.

The proposed tunnel in Baswick parish, is 31 chains long, 20 feet high, and 196 feet below the summit of hill; there are also two small tunnels, the first 7 chains long and 98 feet below the summit of hill; and the other  $4\frac{3}{4}$  chains in length, and 70 feet below the highest part of ground.

#### PRINCIPAL EARTHWORKS.

| Description. | Length. |      | Greatest height or depth. |    | Average height or depth. |    | Locations.                   |
|--------------|---------|------|---------------------------|----|--------------------------|----|------------------------------|
|              | Ms.     | Chs. | Feet.                     |    | Feet.                    |    |                              |
| Cutting ...  | 1       | 00   | ....                      | 88 | .....                    | 35 | Baswick                      |
| Embankment   | 2       | 50   | ....                      | 30 | .....                    | 18 | Rugeley and Armitage.        |
| Cutting..... | 2       | 17   | ....                      | 29 | .....                    | 15 | King's Bromley and Armitage. |
| Cutting. ... |         | 57   | ....                      | 76 | .....                    | 35 | Polesworth.                  |
| Embankment   | 2       | 07   | ....                      | 22 | .....                    | 16 | Mancetter and Witherby.      |
| Embankment   |         | 54   | ....                      | 38 | .....                    | 28 | River Avon.                  |

#### CROSSINGS OF ROADS,& c.

The crossings, according to the section lodged with the Clerk of the Peace for Stafford, consist of twelve turnpike-roads, nine to be passed over the railway and three under; fifty-two highways and parish roads, thirty-two over and twenty under; four occupation roads, three over and one under; thirty brooks, streams, &c. and one level crossing.

The Birmingham and Derby Junction Railway to be passed over at 22 feet above the rails.

The Canals to be crossed by the railway are the Staffordshire and Worcestershire, the Grand Trunk at two places, the Coventry, the Ashby, the Oxford, and the Old Oxford Canal at four places, which are severally to be passed under the railway at 12 feet 6 inches below the rails' top surface.

The rivers to be crossed are the Sowe, the Tame, the Penk, the Avon, and the Anker, at five places.



## REMARKS.

This line is 49 miles 54 chains in length, and consists of three level planes, amounting in length to 10 miles  $32\frac{3}{4}$  chains, and thirteen inclined planes, with gradients ranging from 16 feet per mile, or 1 in 330, to 3·27 feet in a mile, or 1 in 1610. The gradients, therefore, are very favorable.

The Lichfield branch inclines at the rate of 1 in 334, or 15·80 feet per mile.

There are two curves under three-quarters of a mile' radius.

The tunnelling of the main line amounts in length to  $940\frac{1}{2}$  yards.

The principal earthworks, are the Baswick, the King's Bromley, and the Polesworth cuttings; and the Rugeley, Mancetter, and River Avon embankments.

The bridges required for roads, &c. in the main line and branch, are eighty-nine, and the bridges and culverts for brooks, streams, &c. thirty-nine in number.

The clear height allowed for arches over the railway is 14 feet 6 inches, and for road arches under the railway 15 feet 6 inches, allowing in each case 3 feet 6 inches for the thickness of arch and ballasting &c.

## STOURBRIDGE, DUDLEY, AND BIRMINGHAM RAILWAY.

JOHN U. RASTRICK, Esq., Engineer.

This line commences in a plot of ground within 4 chains of High-street, Stourbridge, in the county of Worcester, and passes within 5 chains to the right of the meeting of the Stourbridge and Dudley roads, at the Lye; thence within 9 chains to the right of Rod Mill, on the River Stour, and crossing Netherend; thence passing 15 chains to the right of the River Stour, and 1 chain to the left of the meeting of the



Five Ways, crossing the British Iron Company's Railway at its bend near Reddall Hill, and 7 chains to the left of the turnpike-road at that place; thence crossing the Dudley Canal, and passing the high ground in Rowley Regis parish, by means of a tunnel, and continuing within  $2\frac{1}{2}$  chains and to the right of the buildings at Tat Bank; thence crossing the road at Rude End, 12 chains from the Canal-feeder Bridge, and curving within 7 chains and to the right of Blue Gates, and recurving 5 chains and to the right of Bearward Hill; thence 11 chains to the right of Rotten Park Lodge,  $2\frac{1}{2}$  chains to the right of the Reservoir, in the parish of St. Martin, Birmingham; thence crossing Monument-lane, 2 chains to the right of Ladywood House, and curving to its termination in a small street, 5 chains to the right of the Old Birmingham Canal.

The Dudley Branch diverges from the main line in Halesowen parish, near the road from Halesowen to Oldbury, and curving through Halesowen, Rowley, and Dudley parishes, and passing within  $5\frac{1}{2}$  chains of Dudley Brewery on the right, continues to the intended station in that town.

#### CURVES.

The curves in the main line, under three-quarters of a mile' radius, are, one of 25 chains at Stourbridge; one of 20 chains' at east end of Rowley-Regis Tunnel; and a third, of the same radius, at Birmingham.

#### GRADIENTS, &c.

Datum—200 Feet above Low Water Level, Liverpool.

| Distance from<br>Terminus at<br>Stourbridge. |         | Length of<br>each plane. |       | Gradi-<br>ent. | Inclina-<br>tion. | Ascending or<br>Descending. | Locations.            |
|----------------------------------------------|---------|--------------------------|-------|----------------|-------------------|-----------------------------|-----------------------|
| Miles.                                       | Chains. | Ms.                      | Chs.  | Feet.          |                   |                             |                       |
|                                              | 18·80   |                          | 18·80 |                |                   | Level                       |                       |
|                                              | 46·00   |                          | 27·20 | 52·80          | 1 in 100          | Ascending                   |                       |
| 3                                            | 35·70   | 2                        | 69·70 | 16·04          | 1 in 329          | Ascending                   |                       |
| 4                                            | 40·70   | 1                        | 5·00  | 176·           | 1 in 30           | Ascending                   |                       |
| 10                                           | 00·40   | 5                        | 39·70 |                |                   | Level                       | Tunnel in this plane. |
| 11                                           | 00·40   | 1                        | 00·00 | 52·80          | 1 in 100          | Descending                  |                       |
| 11                                           | 38·00   |                          | 37·60 |                |                   | Level                       | Birmingham.           |



The Dudley Branch is 3 miles 5 chains in length, and rises to Dudley at the rate of 1 in 264, or 20 feet in a mile.

The proposed tunnel, within  $1\frac{1}{2}$  miles of Birmingham, is 1298 yards in length, 25 feet high, and 153 feet 9 inches below the summit of hill.

#### EARTHWORKS—MAIN LINE.

| Description.  | Length. |      | Greatest height<br>or depth. |        | Average height<br>or depth. |     | Locations.               |
|---------------|---------|------|------------------------------|--------|-----------------------------|-----|--------------------------|
|               | Ms.     | Chs. | Feet.                        |        | Feet.                       |     |                          |
| Embankment    | 35      | .... | 60                           | .....  | 20                          | ... | River Stour.             |
| Cutting' .... | 19      | .... | 105                          | .....  | 40                          | ... | By entrance to tunnel.   |
| Cutting ....  | 33      | .... | 60                           | .....  | 25                          | ... | East end of tunnel.      |
| Embankment 1  | 20      | .... | 36                           | . .... | 22                          | ... | Contiguous to above.     |
| Cutting ....  | 69      | .... | 27                           | .....  | 18                          | ... | Harborne parish.         |
| Cutting ....  | 36      | .... | 40                           | .....  | 22                          | ... | Same parish.             |
| Cutting ....  | 37      | .... | 36                           | ....   | 26                          | ... | St. Martin's Birmingham. |
| Cutting ....  | 70      | .... | 23                           | .....  | 16                          | ... | Edgbaston parish.        |

#### CROSSINGS OF ROADS, &c.

The crossings of the main line, according to the Section lodged with the Clerk of the Peace for Stafford, consist of two turnpike-roads, one to be passed over the railway and one under ; twenty-five highways and parish-roads, eleven over and fourteen under ; sixteen occupation-roads, ten over and six under ; two footpaths ; sixteen brooks, streams, &c., and one level crossing. The British Iron Company's Railway to be passed over at an elevation of 22 feet 4 inches above the rails. There are three canal crossings, including the Dudley Canal, which is to be passed under, 22 feet 6 inches below the rails.

The railway to pass over the River Stour at 60 feet above the water's surface.

In the Dudley Branch there are four high-roads and parish-roads, one to be passed over and three under ; five occupation-roads, four over and one under ; and two streams.

#### REMARKS.

This line is 11 miles 38 chains in length, and consists of three level planes, amounting in length to 6 miles 16 chains,



and five inclined planes, with gradients ranging from 176 feet per mile, or 1 in 30, to 16·04 feet in a mile, or 1 in 329.

The steepest plane is 1 mile 5 chains long, inclines at the rate of 1 in 30, and will require a stationary engine.

There are two other planes inclining at the rate of 1 in 100.

There are three curves under three-quarters of a mile' radius.

The tunnelling of the main line amounts in length to 1298 yards.

The principal earthworks are, the River Stour embankment, and that near east end of tunnel, and the two tunnel cuttings, together with those in Harborne and Edgbaston parishes, and that at Birmingham.

The bridges required for roads, &c., in the main line and branch, are fifty-eight, and the bridges and culverts for brooks, streams, &c., twenty in number.

The clear height allowed for arches over the railway is 14 feet 6 inches, and for turnpike-road arches under, 16 feet, allowing, in each case, 4 feet for the thickness of arch and ballasting, &c.

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## TAFF VALE RAILWAY,

### GLAMORGANSHIRE.

I. K. BRUNEL, Esq., F.R.S. Engineer.

There are three branches proposed to leave the Taff Vale Railway, near Plymouth Works; the first is the Dowlais branch, which proceeds by Ysgyhor Newydd; thence curving and recurving in Merthyr Tydfil parish, to the Dowlais Works, the main line continuing in a curvilinear course to Dowlais' Stone Quarry, and the Western Branch running to Morlais Castle Lime Stone Quarry, pursuing a course nearly north by west.

The branch to Pen y darren Works', leaving the Plymouth



Works, runs within 9 chains, and to the left of Ysgyhor Newydd, and terminates at the former, with a curve of 16 chains' radius.

#### DEVIATION OF THE COGAN PILL BRANCH.

This branch passes from a point within 2 chains west of the River Taff, in the parish of Radir, curving and recurving through that parish, and passing on to Ely Farm; thence close to the Cardiff Arms Public House, at Leckwith Bridge, and terminating about a quarter of a mile south by east of the Cardiff Arms.

#### INCLINATIONS, &c.

The Pen y darren branch is 1 mile 14 chains in length, and inclines at the rate of 1 in 264.

The Dowlais branch is 3 miles  $3\frac{3}{4}$  chains in length, and consists of four planes, having inclinations of from 1 in 10, to 1 in 264.

The branch to Morlais Stone Quarry, is 1 mile  $41\frac{3}{4}$  chains long, and is arranged in three planes, having inclinations of 1 in 11, and 1 in 264.

The Cogan Pill branch deviation is 3 miles 4 chains in length, and falls at the rate of 1 in 448.

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### TAW VALE RAILWAY.

DANIEL BENYON, Esq., Civil Engineer.

This line commences at the proposed Breakwater at Penhill, in the parish of Fremington, and is intended to pass under Penhill by means of a tunnel, 16 chains in length; thence by an embankment about 5 feet high to Lake. A branch of about a quarter of a mile in length, leaves the main line, and proceeds to Barnstaple with a curve of about 17 chains' radius; the curve at Lake in the main line is about 8 chains' radius; the turn-



pike-road to Barnstaple is to be carried over the railway 15 feet above the rails, by an arch 18 feet wide and 13 feet high ; the approaches of the turnpike-road to be 1 in 30.

The whole length of the main line is 3 miles 28 chains, and level.

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## TRURO, REDRUTH, AND PENZANCE RAILWAY.

SAMUEL MOYLE, Esq., Engineer.

This line commences near Penlea Point, and running nearly parallel with the shore of Mounts Bay to Newlyn, passes to the left of Newlyn Pier ; thence curving to the right of Street-an-Nowan, and passing close on the right of Lariggan Bridge, still skirting the shore to the Town of Penzance ; thence quickly curving towards the pier, and recurving to the right of Chyandour ; thence close on the right of Pons-an-dane Bridge, skirting Penzance Green, and passing to New Town ; thence to the left of Wheal Darlington Mine, continuing to Truthwall, and passing to the left of Wheal Prosper and Trevarthen Mines ; thence passing on the left of Wheal Osborne, to the right of Nanjenkin, 3 chains to the right of Wheal Gilbert, 6 chains to the left of Noonverse ; thence to the left of North Godolphin Mine, passing on the left of Binner Farm, and the right of Wheal Julia ; thence to the left of Clowance Park, across Hoe Common, and to the right of Baripper village, between Higher Penponds and Lower Penponds, 8 chains to the left of Crane Farm, and to the left of Dunstanville Mines ; thence to Lower Rosewarne, crossing the Hayle Railway, in Illogan parish,  $5\frac{1}{2}$  chains to the right of Tolgus Mine, near which the Redruth Branch diverges ; the main line continuing 3 chains to the right of Wheal Harmony, passing to



Scorrier Gate, crossing the Portreath Tramroad, and curving through Chacewater, leaving the Kennel, in the parish of Kenwyn, close on the left; thence passing 3 chains to the left of Lanegarth, 4 chains to the left of St. Coose, 5 chains to the left of Coosebean Mill,  $2\frac{1}{2}$  chains to the left of Hendra; thence continuing to its termination at Castle Hill, Truro.

The Hayle Branch runs through St. Hillary parish, 8 chains to the right of Tregelhowe; thence to the left of Frighton, 9 chains to the left of Trevissa, and to the right of Trewinnard; thence to St. Erth, and to the left of Chenhalls; thence curving to its termination at Hayle Iron Foundry, in St. Erth parish.

#### GRADIENTS, &c.

The whole length of the main line is 26 miles 54 chains, and consists of twenty-six inclined planes, ranging from 1 in 43 to 1 in 1532. Besides the plane of 1 in 43, there are several other steep planes, which severally incline at the rate of 1 in 51, 1 in 58, and 1 in 64.

Several short branches are proposed, with inclinations varying from 1 in 27 to 1 in 340; there are twelve curves, varying from  $3\frac{1}{2}$  to 28 chains' radius.

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## WARWICK, LEAMINGTON, AND COVENTRY RAILWAY.

ROBERT STEPHENSON, Esq., Engineer.

This line is intended to commence near the Portobello Tavern, at Emscote, in the parish of St. Nicholas, and Borough of Warwick, 2 chains from the Bridge over the Warwick and Napton Canal; thence crosses the turnpike-road from Coventry to Warwick, 14 chains to the north of the Canal, and curving



through the parish of Leek Wooton, 4 chains to the right of Mr. Cook's House ; thence crosses the road from Beansall to Kenilworth, and passing 2 chains to the left of Mr. Hick's, at Kenilworth, again crosses the same road twice beyond ; thence passing to Kenilworth, and crossing the road from Coventry to Warwick, 9 chains to the left of the meeting of the four roads ; thence continuing in a direct line through Kenilworth and Stone Leigh parishes, and crossing the road from Stone Leigh to Kenilworth ; thence again crossing the turnpike-road from Coventry to Kenilworth, in Stone Leigh parish, and passing 5 chains to the right of Mr. Butler's House ; thence through Mr. Chandos Leigh's Wood, in Stone Leigh parish ; and thence curving off to the London and Birmingham Railway, in the parish of St. Michael, Coventry, by two lines, the one meeting that railway by the road from Hearsall Common to Stivichall, and the other near Mr. Thomas Harris's Farm-house, in Stone Leigh parish.

The two curves at junction with the London and Birmingham Railway, are each of 55 chains' radius.

## GRADIENTS, &amp;c.

Datum—188 feet 5 inches below Birmingham and Warwick Canal at Emscote.

| Distance from Junction with the London and Birmingham Railway. |         | Length of each plane. |      | Gradient. | Inclination. | Ascending or Descending. | Locations.                                  |
|----------------------------------------------------------------|---------|-----------------------|------|-----------|--------------|--------------------------|---------------------------------------------|
| Miles.                                                         | Chains. | Ms.                   | Chs. | Feet.     |              |                          |                                             |
| 2                                                              | 7       | 2                     | 7    | 20·62     | 1 in 256     | Descending               | Near Road from Stone Leigh to Allersley.    |
| 3                                                              | 15      | 1                     | 8    | 4·54      | 1 in 1161    | Ascending                | Turnpike-road from Coventry to Warwick.     |
| 4                                                              | 53½     | 1                     | 38½  | 14·87     | 1 in 355     | Descending               | Ditto.                                      |
| 6                                                              | 39½     | 1                     | 66   |           |              | Level                    |                                             |
| 7                                                              | 57¾     | 1                     | 18¼  | 44·00     | 1 in 120     | Descending               |                                             |
| 8                                                              | 56      |                       | 78¼  | 13·33     | 1 in 396     | Descending               | Road from Warwick to Leamington at Emscote. |



The branch to the London and Birmingham Railway is one mile in length, and ascends thereto, at the rate of 1 in 129, or 40·93 feet per mile.

## PRINCIPAL EARTHWORKS.

| Description. | Length. |      | Greatest height<br>or depth. |       | Average height<br>or depth. |     | Locations.                              |
|--------------|---------|------|------------------------------|-------|-----------------------------|-----|-----------------------------------------|
|              | Ms.     | Chs. | Feet.                        |       | Feet.                       |     |                                         |
| Embankment   | 60      | .... | 27                           | ..... | 20                          | ... | Road from Stone Leigh to Allersley.     |
| Cutting .... | 42      | .... | 36                           | ..... | 20                          | ... | Road to Crifield.                       |
| Embankment   | 53      | .... | 40                           | ..... | 22                          | ... | Turnpike-road from Coventry to Warwick. |
| Cutting .... | 28      | .... | 65                           | ..... | 35                          | ... | Between 3 and 4 miles.                  |
| Cutting .... | 1       | 10   | ....                         | 35    | ...                         | 22  | Roundshill Lane.                        |
| Cutting .... | 30      | .... | 37                           | ..... | 22                          | ... | At 7 miles.                             |
| Embankment   | 60      | .... | 23                           | ..... | 16                          | ... | Near Emscote.                           |

## CROSSINGS OF ROADS, &amp;c.

The crossings, according to the Section lodged in the Private Bill Office, consist of three turnpike-roads, one to be passed over the railway and two under ; fifteen highways and parish-roads, nine over and six under ; six occupation-roads, four over and two under ; seven brooks, streams, &c.

## REMARKS.

This line and branch together, are 9 miles 56 chains in length, and consist of one level plane, 1 mile 66 chains in length, and six inclined planes, with gradients ranging from 44 feet per mile, or 1 in 120, to 4·54 feet in a mile, or 1 in 1161.

The steepest plane is 1 mile  $18\frac{1}{4}$  chains long, and inclines at the rate of 1 in 120.

There are two curves under three-quarters of a mile' radius.

The principal earthworks are the embankment at road from Stone Leigh to Allersley, and the Rounds Hill-lane cutting.

The bridges required for roads, &c., are twenty, and the bridges and culverts for brooks, streams, &c., seven in number.



The clear height allowed for arches over the railway, is 16 feet, and for turnpike-road arches under 17 feet, allowing 4 feet for the thickness of arch and ballasting, &c., in each case.

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## WEARDALE JUNCTION RAILWAY,

Also known as

## THE NEW SOUTH DURHAM RAILWAY.

ROBERT NICHOLSON, Esq., Engineer.

This line commences at Frosterley and takes a curvilinear course eastward, crossing the River Wear at an angle of  $58^{\circ}$  near the Limekiln, in the parish of Stanhope; thence continuing to the north and within 2 chains of Broadwood, whence the Bishopley branch diverges; the main line thence keeping south of the river, passing north of Landieu, and between the Mill and Ashes in South Wolsingham Quarter, and approaching within 3 chains of the river near Wolsingham, crosses it with a quick curve at the division between Wolsingham Town Constabulary and Bradley Hall Township; thence passing a quarter of a mile to the south of Bradley Hall, and in a direction a little to the east of north, continues to the south of Castle Wood and Elm Park; thence within 10 chains north of Roddy Moor, three-quarters of a mile beyond which the Harperley branch diverges to the south-west, the main line proceeding to within 5 chains south of Billy Hall, within 8 chains of Black Hamilton, near which the divergence of the Stanley branch commences; the main line thence pursuing a direct course to the north-east of Willington Burn, and within 3 chains thereof; thence passing near to Willington Old Hall, which is south-west of the line, again crosses the Wear, and passes within 2 chains



south-west of Toddles ; and thence continues to its junction with the Byer's Green Branch of the Clarence Railway, in the Township of Old Park.

### CURVES.

The curves under three-quarters of a mile' radius, in the main line, are as follows :—

| Nos.    | Curvatures in Chains. | Locations.                                        |
|---------|-----------------------|---------------------------------------------------|
| 1 ..... | 8 .....               | Frosterley Township.                              |
| 2 ..... | 10 .....              | Near Broad Wood.                                  |
| 3 ..... | 50 .....              | Near second crossing of the River Wear.           |
| 4 ..... | 27 .....              | Near Bradley Hall.                                |
| 5 ..... | 50 .....              | Near Elm Park.                                    |
| 6 ..... | 13 .....              | Near Billy Hall.                                  |
| 7 ..... | 48 .....              | Near Willington Old Hall.                         |
| 8 ..... | 32 .....              | Near Byer's Green Branch of the Clarence Railway. |

In the Bishopley branch there are two curves, each of 10 chains' radius.

### GRADIENTS, &c.

The whole length of the main line from Frosterley to the Byer's Green Branch of the Clarence Railway, is 13 miles  $41\frac{1}{2}$  chains. The planes are twenty-five in number, and range in point of inclination from 1 in 14·20 to 1 in 1193. The steepest planes are one which inclines at the rate of 1 in 14·20 for  $35\frac{3}{4}$  chains, a second of 1 in 14·5 for  $50\frac{1}{2}$  chains, a third of 1 in 18·166 for 65 chains, a fourth of 1 in 18·20 for 1 mile  $25\frac{1}{4}$  chains, a fifth of 1 in 21·88 for  $29\frac{1}{2}$  chains, two of 1 in 22, and so on.

The Stanley branch is 1 mile 2 chains long, and consists of four planes, inclining at the rate of from 1 in 29·66 to 1 in 280.

The Harperley branch consists of two planes, the first level for  $2\frac{1}{4}$  chains, and the second inclining at the rate of 1 in 19·20 for  $32\frac{1}{2}$  chains in length.



The Bishopley branch is 1 mile 11 chains in length and is arranged in two planes, the first inclining at the rate of 1 in  $44\frac{1}{2}$  for 49 chains, and the second descending at the rate of 1 in 64.

#### CROSSINGS OF ROADS, &c.

The crossings, according to the section lodged in the office of the Clerk of the Peace for Durham, consist of three turnpike-roads to be passed over the railway; thirteen highways and parish roads, six over and seven under; four brooks, streams, burns, &c., and four level crossings.

The railway to cross the River Wear at 17 feet 6 inches, 18 feet, and 26 feet above the rails' top surface, in each case respectively.

#### REMARKS.

The whole length of the main line and branches is 16 miles  $9\frac{1}{4}$  chains.

The curves under three-quarters of a mile' radius, are eight in number

The earthworks are not very material.

There are nineteen bridges required for roads, rivers, &c. and four bridges and culverts for streams, &c. The extreme height allowed for turnpike-road crossings under the railway is 10 feet 6 inches.

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### WEST DURHAM RAILWAY.

The southern line commences in the Township of Merrington, at the Chilton Branch Railway-End, and passes 6 chains south of Craw Law; thence within 5 chains south of Close House, and curving in a north-westerly direction, within 10 chains north of the Church, in South Church-parish,



about 3 furlongs beyond which it joins the northern line ; thence proceeding within 2 chains to the west of Wood-house Close, and within 4 chains of Broken Backed House, 13 chains to the north of Saint Helen's, Auckland Colliery ; thence to the Stockton and Darlington Railway, at St. Helen's, Auckland ; the Hagger Leases Branch Railway diverges in a westerly direction.

The northern line passes 20 chains north of Craw Law, crosses the road from Eldon to Merrington, about 23 chains to the north of Craw Law ; thence passing through Coundon, and proceeding in a direct course to its junction with the south line, in the Township of St. Andrew, Auckland.

#### CURVES.

In the south line there are two curves, each of 30 chains' radius, near Craw Law ; a third at meeting of roads from Eldon to Merrington ; and, lastly, one of 16 chains' near Broken Backed House.

In the Bishop-Auckland branch there are two curves, each of about 15 chains' radius.

#### GRADIENTS, &c.—NORTHERN LINE.

Datum—100 feet below the Chilton Branch Railway at point of Junction.

| Distance from Junction with Chilton Branch. |         | Length of each plane. |      | Gradient. | Inclination. | Ascending or Descending. | Locations.                       |
|---------------------------------------------|---------|-----------------------|------|-----------|--------------|--------------------------|----------------------------------|
| Miles.                                      | Chains. | Ms.                   | Chs. | Feet.     |              |                          |                                  |
| 0                                           | 35      | 0                     | 35   | 32·       | 1 in 165     | Ascending                |                                  |
| 1                                           | 4       | 0                     | 49   | 136·32    | 1 in 38·73   | Ascending                |                                  |
| 1                                           | 59      | 0                     | 55   | 13·82     | 1 in 382     | Descending               |                                  |
| 2                                           | 75      | 1                     | 16   | 106·23    | 1 in 49·69   | Descending               |                                  |
| 3                                           | 75      | 1                     | 00   |           |              | Level                    |                                  |
| 4                                           | 66      | 0                     | 71   | 33·84     | 1 in 156     | Ascending                |                                  |
| 5                                           | 66      | 1                     | 00   | 5·        | 1 in 1056    | Ascending                |                                  |
| 6                                           | 28      | 0                     | 42   | 24·78     | 1 in 213     | Ascending                | Stockton and Darlington Railway. |

The southern line is 4 miles 16 chains in length, and consists



of four inclined planes, whose inclinations are, 1 in 179, 1 in 26·15, 1 in 316, 1 in 23·64, and 1 in 264.

The Bishop-Auckland branch is 1 mile 15 chains in length, and rises at the rate of 1 in 196.

The Hagger Leases branch is 15·90 chains long, and falls at the rate of 1 in 262·5.

#### CROSSINGS OF ROADS, &c.

The crossings of the main line and branches, according to the Section lodged in the Office of the Clerk of the Peace at Durham, consist of fourteen highways and parish roads, seven to be passed over the railway and seven under; six railways and tramways, three over and three on the level; and seven level crossings.

The railway to pass over the River Gaunless, at 54, and again at 82 feet above the water's surface in each case.

#### REMARKS.

This line and branches is 11 miles 74·90 chains in length; the main line consists of one level plane, in length one mile, and three inclined planes, with gradients ranging from 136·32 feet per mile, or 1 in 38·73, to 5 feet in a mile, or 1 in 1056.

The steepest plane is 49 chains long, and inclines at the rate of 1 in 38·73.

The inclinations of the branches range from 1 in 23·64, to 1 in 316.

There are six curves under three-quarters of a mile' radius.

The earthworks are not important.

The bridges required for roads, railways, &c., in the main line and branches, are twenty in number.

The clear height allowed for arches under the railway is 13 feet 6 inches, allowing 3 feet for the thickness of arch and ballasting, &c.

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## WESTMINSTER BRIDGE, DEPTFORD, AND GREENWICH RAILWAY.

H. H. PRICE, Esq. Civil Engineer.

The intended London Depôt of this line is proposed to be formed on the site of buildings and ground lying between Bridge-street, the Thames, and Stangate, close to Westminster Bridge, on the Surrey side of the river, from whence the line proceeds across Stangate New Road, Upper Marsh, Royal-street, Carlisle-street, Homer-street, Hercules-buildings, North-street, South-street, Lambeth-road, Little Canterbury-place, Saint Alban's-street, Richmond-street, Westminster-road at Walcot-place, Chester-gardens, Chester-street, Kennington-lane, White Hart-street, Kennington-road, Back-lane, South-place, Royal-street, Wheeler's-lane, Hill-street, Kennington-street, Windmill-lane, Collingwood-street, Bowyer-lane, Leipsic-road, High-street, Green's-row, Great Orchard-road, George-street, and Waterloo-street; thence across Camberwell Vicarage-ground, and the Workhouse Garden, across Havil-street, South-street, Southampton-street, Pit-street, John-street, Charles-street, Smith-street, and crossing the Peckham branch of the Grand Surrey Canal, Hill-street, Park-road, Park-place and Black Club-row; thence across the Old Kent-road, at Carlton Cottages, and passing to the left of Hatcham Dairy, near which a deviation is proposed to join the Croydon Railway, the main line proceeding across the Willow Plot; thence crossing Cold Blow Farm-lane, and entering the County of Kent; thence with a curve of three-quarters of a mile' radius, terminating at the Deptford Depôt of the London and Greenwich Railway.



## GRADIENTS, &amp;c.—MAIN LINE.

Datum—Trinity High Water, River Thames.

| Length of<br>each plane. | Gradi-<br>ent. | Inclina-<br>tion. | Ascending or<br>descending. | Locations.                                |
|--------------------------|----------------|-------------------|-----------------------------|-------------------------------------------|
| Feet .                   | Feet.          |                   | Level                       | New Palace Road.                          |
| 400                      |                |                   |                             |                                           |
| 835                      | 23·78          | 1 in 222          | Descending                  | Royal-street.                             |
| 2100                     | 15·95          | 1 in 331          | Ascending                   | Near Walcot Place.                        |
| 7675                     | 1·71           | 1 in 3070         | Descending                  | High-street, Camberwell.                  |
| 7200                     |                |                   | Level                       |                                           |
| 2200                     | 4·99           | 1 in 1057         | Ascending                   | Dovor Road.                               |
| 2289                     | 17·48          | 1 in 302          | Ascending                   | Crossing of Croydon Railway.              |
| 3470                     | 14·95          | 1 in 353          | Ascending                   | Greenwich Railway at Deptford<br>Station. |

The first branch to the Croydon Railway is 3010 feet in length, and descends to that way at the rate of 1 in 269; the other branch to the same railway, is 2725 feet in length, and falls at the rate of 1 in 198.

There is a diversion shewn in the plan by the Upper Marsh, which is 1 mile 20·22 chains long, and is divided into three planes, whose inclinations are severally 1 in 220, 1 in 330, 1 in 3070.

## REMARKS.

The main line is 4 miles 76·50 chains in length, and consists of two level planes, amounting in length to 1 mile 35·15 chains, and six inclined planes, with gradients ranging from 23·78 feet per mile, or 1 in 222, to 1·7 feet per mile, or 1 in 3070.

The steepest plane is 835 feet in length.

The branches to the Croydon Railway are together 1 mile 6·83 chains in length, the former inclining at the rate of 1 in 269 and the latter at 1 in 198.

The railway is proposed to be carried over the roads and streets by a viaduct, beneath which it is intended to form an arcade of light and elegant design, with shops on either side,



resembling much in appearance the interior of the Lowther Arcade ; with this view the width of ground to be taken is 170 feet, about 30 feet of which is for the railway and the remaining space for building sites.

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## YORK AND NORTH MIDLAND RAILWAY.

### PROPOSED DEVIATIONS.

G. STEPHENSON, Esq., Engineer.

The first of the two branches which are intended to communicate with the North Midland Railway, diverges from that line at 69 chains from the junction of the Original Normanton Branch ; the other, or Methley Branch, joins the same railway one mile from the first : these two uniting, pursue a course on the north side of the River Aire, and approach it within 5 chains, in the Township of Fairburn ; thence curving to the east, and recurving in a north-easterly direction, to the first point of divergence of the new line to the Leeds and Selby Railway. The second point of divergence of this new line is 1 mile 11 chains from the first.

The second, or northern diversion of the main line, commences in the parish of Sherburn, 47 chains to the south of Row Farm, and proceeds, slightly curving, to Ulleskelfe, at a distance from the original Parliamentary line of 52 chains, and to the east thereof, and crosses the River Wharfe, just beyond Ulleskelfe, whence it continues nearly in a right line to its junction with the Parliamentary line in Copmanthorpe Moor.

The curves are much improved ; those of the branches to the Leeds and Selby Railway being not less than three-quarters of a mile' radius.

### GRADIENTS, &c.

The proposed northern deviation is 7 miles 55 chains in length, and consists of one level plane, 2 miles 25 chains in



length ; and two inclined planes, with gradients of 4 feet and 2·33 feet per mile, respectively.

The southern diversion is 8 miles in length, and consists of four inclined planes, with gradients ranging from 8 to 5 feet per mile. In this diversion a tunnel is intended under the Ferry-bridge and Boroughbridge turnpike-road, 220 yards in length.

The Normanton Branch is 1 mile  $64\frac{1}{2}$  chains in length, and falls to the main line at the rate of 1 in 620, or 8·41 feet per mile.

The deviation to the Leeds and Selby Railway is 2 miles 46 chains in length, and consists of two planes, with gradients of 9 and 4 feet per mile respectively.

The earthworks in the several proposed diversions are generally slight ; those most worthy of notice are, an embankment, extending from Sand-pit Road to near the south end of tunnel, 4 miles in length, and averaging about 12 feet in height, and a cutting at the north end of proposed tunnel, 44 chains long, 70 feet deep by tunnel, and averaging 25 feet.

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## LONDON AND EXETER RAILWAY.\*

FROM READING TO TAUNTON.

FREDERICK TWYNAM, Esq., Civil Engineer.

This intended railway leaves the Bristol and Exeter Railway by two curved lines in the parishes of Durston and Lyng ; and thence passes in a direct course to Stoke St. Gregory, and continues in a right line to Langport ; thence slightly curves 21 chains to the left of Huish Episcopal Church, and passing to Upton, continues within 12 chains and to the right of High-

\* This line should have been placed in its proper alphabetical order. The omission occurred in consequence of a misunderstanding with regard to the title, there being another intended Railway known nearly by the same name.



brooks, in Somerton parish, 3 chains to the left of Catsgoregate, passing to the right of Kingsdon, 10 chains to the right of Popple Bridge, 16 chains to the right of Puddemore Farm; thence passing to Annis Hill, and Downhead, 27 chains to the left of Weston-Bamfylde Church, and 8 chains to the right of Spackford Church, 11 chains to the left of the New Inn, at South Cadbury; thence to Compton-Pouncefoot, and close on the left of Blackford, passing to the left of Maperton, and through the high ground at Holton by means of a tunnel, passing through the isolated portion of the parish of Holton, and the parish of Charlton-Musgrave; thence curving through the parishes of Wincanton and Horsington, and by a tunnel under the high ground at Bainly Bottom; thence 7 chains to the left of Slaughter-gate Farm; thence to Peace Marsh, 4 chains to the right of Lawn Bridge, in the parish of Gillingham; thence entering the county of Wilts, and passing 3 chains to the left of Woodhouse, 9 chains to the right of Coleman's Farm, passing to the right of Old-street, in the East Knoyle Parish,  $3\frac{1}{2}$  chains to the right of Bale Bridge; thence skirting Wardone Park on the right, and passing 12 chains to the right of East Hatch, 10 chains to the right of Wickwood, 6 chains to the left of Wick Farm, 6 chains to the right of Tisbury Church, and close to the Mill in the same parish; thence to the right of Chick's Grove Mill, 1 chain to the right of Leigh Barn, in the parish of Teffont-Evias, 3 chains to the right of Dalen Farm; thence passing to Dinton, 9 chains to the left of Baverstock Church, close to the Stone Quarry, in the parish of Barford St. Martin,  $1\frac{1}{2}$  chains to the right of North Burcombe Church, passing between it and South Burcombe, continuing through the parishes of Wilton, Northampton, West Harnham, Bretford, and through the liberty of the Close, Salisbury; thence through Milford Parish, and that of Laverstock, 18 chains to the right of St. Thomas' Bridge; thence through the parishes of Winterbourne-Earls, Winterbourne-Dauntsey, and Winterbourne-Gunner, 15 chains to the left of Idmiston Farm; thence running parallel, and on the right of the Roman



Road, in the parish of Newton Tiney, close on the right of Hampshire Gap, 12 chains to the right of Lone Down Farm; thence close on the right of Grateley; thence to Gollard's Farm, 9 chains to the right of Abbots Anne Mill; thence through Andover parish, 6 chains to the left of Newland Farm, 10 chains to the right of Chapman's Ford; thence through Cowden Woods, passing through Whitchurch parish, 13 chains to the left of Treefolk Park, in Laverstoke parish; thence through the parishes of Overton, Ashe, and Dean, 12 chains to the left of Clarken Green, 19 chains to the left of Oakley Dell, where the branch to the Southampton Railway curves off through Newfoundland, and joins that line in the parish of Worthing, the main line passing to the left of Worthing Park, and through the parishes of Basingstoke and Sherborne St. John, 7 chains to the left of Crisham House; thence passing to Pyott's Hill, where a second branch diverges to the Southampton Railway, passing within 2 chains and on the left of Lickpit Farm; the main line continues 3 chains to the right of Basing Lodge, 9 chains to the right of the Vicarage, in Sherfield-on-Lodden parish, passing to the left of Sherfield Green, 8 chains to the left of Lilly's Mill; thence through the parish of Strath-field-saye, to the right of Beech Hill, 17 chains to the left of Spencer's Common, running nearly parallel with Woodcock-lane; thence to Lea Common, passing through the parish of St. Giles, 9 chains to the left of the Marquis of Granby public-house, and terminating at the Great Western Railway in the parish of Sonning.

A branch leaves the main line in the Hamlet of Whiteley, and terminates in St. Giles' parish, Reading.

#### CURVES.

In the branch leaving the Bristol and Exeter Railway there is one curve of a quarter of a mile' radius; two of half a mile, in branches in Queen's Camel parish; and one of half a mile in the parishes of Wootton St. Lawrence and Worthing, at junction with London and Southampton Railway.



The branches to Sherborne Yeovil leave the main line in Queen's Camel parish, and proceed together nearly in a direct line to the right of Marston Inn; thence to Stammer, and to the right of Trent Church, where the two branches diverge, that to Sherborne passing to Lower Compton, and by a tunnel under the high ground in Nether Compton parish, and thence curving to its intended termination at Sherborne.

The branch to Yeovil curves through Over-Compton parish, and terminates at Yeovil.

Leaving the main line, there is a curve in Queen's Camel parish, of half a mile' radius, and a second of 50 chains', at the same place; one of 45 chains' in the Sherborne Branch, at its divergence from the Yeovil Branch, and a second, of the same radius, in Sherborne parish.

## GRADIENTS, &amp;c.

Datum—Assumed High Water Level.

| Distance from<br>Bristol and<br>Exeter Railway. |         | Length of<br>each Plane |       | Gra-<br>dient. | Inclina-<br>tion. | Ascending or<br>Descending. | Locations.                           |
|-------------------------------------------------|---------|-------------------------|-------|----------------|-------------------|-----------------------------|--------------------------------------|
| Miles.                                          | Chains. | Ms.                     | Chs.  | Feet.          |                   |                             |                                      |
|                                                 | 78·75   | 0                       | 78·75 | 8·13           | 1 in 649          | Descending                  |                                      |
| 7                                               | 40·     | 6                       | 41·25 |                |                   | Level.                      | Near turnpike-road<br>to Somerton.   |
| 14                                              | 59·     | 7                       | 19·   | 6·36           | 1 in 830          | Ascending                   |                                      |
| 22                                              | 00·     | 7                       | 21·   | 16·            | 1 in 330          | Ascending                   |                                      |
| 23                                              | 40·     | 1                       | 40·   | 44·            | 1 in 120          | Ascending                   | Near road to Maper-<br>ton Railway.  |
| 26                                              | 00·     | 2                       | 40·   |                |                   | Level                       | Tunnel in this plane.                |
| 31                                              | 40·     | 5                       | 40·   | 3·45           | 1 in 1528         | Ascending                   | Near River Stour.                    |
| 33                                              | 00·     | 1                       | 40·   |                |                   | Level                       | Near River Ledden.                   |
| 37                                              | 60·     | 4                       | 60·   | 16·            | 1 in 330          | Ascending                   | Road to Pyt House.                   |
| 54                                              | 20·     | 16                      | 40·   | 10·66          | 1 in 495          | Descending                  |                                      |
| 55                                              | 34·     | 1                       | 14·   |                |                   | Level                       |                                      |
| 58                                              | 35·     | 3                       | 01·   | 34·28          | 1 in 154          | Ascending                   |                                      |
| 64                                              | 06·50   | 5                       | 51·   | 14·91          | 1 in 354          | Ascending                   | Tunnel in this plane.                |
| 69                                              | 34·     | 5                       | 27·50 | 20·46          | 1 in 258          | Descending                  |                                      |
| 72                                              | 64·     | 3                       | 30·   | 2·66           | 1 in 1980         | Descending                  |                                      |
| 79                                              | 31·75   | 6                       | 47·75 | 1·36           | 1 in 3870         | Ascending                   | Tunnel in this plane.                |
| 84                                              | 51·50   | 5                       | 19·75 | 4·57           | 1 in 1154         | Ascending                   |                                      |
| 87                                              | 26·     | 2                       | 54·50 | 12·30          | 1 in 429          | Ascending                   | Summit.                              |
| 90                                              | 64·50   | 3                       | 38·50 | 42·24          | 1 in 125          | Descending                  |                                      |
| 99                                              | 44·     | 8                       | 59·50 | 12·60          | 1 in 419          | Descending                  |                                      |
| 104                                             | 17·75   | 4                       | 53·75 |                |                   | Level                       | Tunnel in this plane.                |
| 105                                             | 48·     | 1                       | 30·25 | 8·71           | 1 in 606          | Descending                  | Level of Great West-<br>ern Railway. |



The branch to the Bristol and Exeter Railway is 42 chains in length, and descends to that line at the rate of 1 in 693, or 7·61 feet per mile.

The first branch to the Southampton Railway is 1 mile 18 chains long, and falls to that line at the rate of 1 in 161, or 32·79 feet in a mile. The second branch to the same railway is 1 mile 27·5 chains long, and falls at the rate of 1 in 131, or 40·30 feet in a mile. The branch to the canal at Reading falls to the intended station at the rate of 1 in 259, or 20·38 feet in a mile.

## TUNNELS.

| Nos.    | Length.<br>Yards. | Height.<br>Feet. | Inclination.    | Locations.                        |
|---------|-------------------|------------------|-----------------|-----------------------------------|
| 1 ..... | 770 .....         | 23 .....         | Level .....     | Near 26 miles.                    |
| 2 ..... | 2200 .....        | 23 .....         | 1 in 1528 ..... | Under road to Gillingham.         |
| 3 ..... | 286 .....         | 23 ..            | 1 in 154 .....  | Under London-road, near 58 miles. |
| 4 ..... | 440 .....         | 23 .....         | 1 in 3870 ..... | Near Falconer's Farm.             |
| 5 ..... | 440 .....         | 23 .....         | Level .....     | Near Great Western Railway.       |

## PRINCIPAL EARTHWORKS.

| Description. | Length |      | Greatest height<br>or depth. |       | Average height<br>or depth. |       | Locations.                                        |
|--------------|--------|------|------------------------------|-------|-----------------------------|-------|---------------------------------------------------|
|              | Ms.    | Chs. |                              | Feet. |                             | Feet. |                                                   |
| Cutting..... | 0      | 43   | ....                         | 65    | .....                       | 30    | Between 2 and 3 miles.                            |
| Cutting..... | 0      | 53   | ....                         | 50    | .....                       | 32    | Between 3 and 4 miles.                            |
| Cutting..... | 1      | 16   | ....                         | 48    | .....                       | 30    | Between 10 and 12 miles.                          |
| Embankment   | 2      | 46   | ....                         |       | .....                       | 33    | Between 13 and 17 miles.                          |
| Cutting..... | 3      | 48   | ...                          | 78    | .....                       | 24    | Between 20 and 24 miles.                          |
| Cutting..... | 0      | 47·5 | ....                         | 86    | .....                       | 32    | Turnpike-road from Sherborne, east end of Tunnel. |
| Embankment   | 2      | 10   | ....                         | 35    | .....                       | 26    | 25 and 27 miles.                                  |
| Cutting..... | 1      | 10   | ....                         | 86    | .....                       | 40    | End of Long Tunnel.                               |
| Cutting..... | 1      | 57   | ....                         | 72    | .....                       | 34    | Near Voler Spring.                                |
| Cutting..... | 1      | 49   | ....                         | 46    | .....                       | 22    | 44 and 47 miles.                                  |
| Embankment   | 1      | 8    | ....                         | 38    | .....                       | 34    | Road from Salisbury to Rascombe Church.           |
| Cutting..... | 1      | 20   | ....                         | 66    | .....                       | 38    | Road from Wilton to Bishopstone.                  |



| Description. | Length. |      | Greatest height<br>or depth. |    | Average height<br>or depth. |    | Locations.                 |
|--------------|---------|------|------------------------------|----|-----------------------------|----|----------------------------|
|              | Ms.     | Chs. | Feet.                        |    | Feet.                       |    |                            |
| Cutting..... | 1       | 50   | ...                          | 40 | .....                       | 26 | Road to Shippen.           |
| Cutting..... | 1       | 22   | ...                          | 63 | .....                       | 27 | Devil's ditch.             |
| Cutting..... | 1       | 50   | ...                          | 40 | .....                       | 25 | Between 76 and 79 miles.   |
| Cutting..... | 2       | 20   | ...                          | 42 | .....                       | 26 | Between 98 and 102 miles.  |
| Embankment   | 1       | 72   | ....                         |    | .....                       | 15 | Between 101 and 104 miles. |

The two branches to the Southampton Railway are chiefly in cutting.

#### CROSSINGS OF ROADS, &c.

According to the Section lodged in the Private Bill Office, there are twenty-six turnpike-roads to be crossed by this railway, thirteen to be passed over and thirteen under ; one hundred and twenty-eight highways and parish-roads, seventy-three over and fifty-five under ; one hundred and seventeen occupation-roads, fifty-three over and sixty-four under ; forty-one foot-paths ; sixty - two brooks, streams, &c., and twelve river crossings, including the Perrett, the Stour, the Shreenwater, the Ledden, two crossings of the Nadder, and the Avon.

The turnpike -road to Somerton, that from Salisbury to Blanford, and the road to Laverstock, severally to be diverted.

#### REMARKS.

The whole length of the main line from the Bristol and Exeter Railway, to the Great Western Railway, at Reading, is 105 miles 48 chains. The planes are twenty-two in number, of which five are level, and amount in length to 14 miles 69 chains, and 17 inclined, ranging in point of gradient, from 44 feet per mile, or 1 in 120, to 1.36 feet in a mile, or 1 in 3870.

There are two planes requiring assistant engines.

The eastern terminal plane is on an ascent from the Great Western Railway, and that contiguous to the Bristol and Exeter Railway descends from that line.

The collective length of the branches is 4 miles 37.50 chains.



The steepest gradient is 40·30 feet per mile in the second branch to the Southampton Railway.

The summit is 374 feet above the Bristol and Exeter Railway at point of divergence, and 87 miles 26 chains therefrom; and 268 feet above rails of Great Western Railway, at point of junction, in a length of 18 miles 22 chains.

The whole length of tunnelling, is 2 miles 616 yards.

The bridges required for roads, rivers, &c., are three hundred and twenty-four in number, and the bridges, aqueducts, and culverts for brooks, streams, &c., sixty-two in number.

The clear height allowed for turnpike-road arches under the railway is 16 feet.



No. I.—TABLE OF DISTANCES from the proposed Railway Termini, in London, to Eight principal Points therein.

TABLE OF DISTANCES.

259

| Proposed London Termini.                            | TITLES.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Charing Cross. | Regent Circus, Oxford-street. | Royal Exchange. | Holborn Bars. | Yorkshire Stingo, New Road. | Angel Inn, Islington. | Mile End Gate. | Elephant and Castle. |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------------------|-----------------|---------------|-----------------------------|-----------------------|----------------|----------------------|
|                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Ms. Chs.       | Ms. Chs.                      | Ms. Chs.        | Ms. Chs.      | Ms. Chs.                    | Ms. Chs.              | Ms. Chs.       | Ms. Chs.             |
| Euston-square .....                                 | London and Birmingham.....<br>Cheltenham, Oxford, and London<br>and Birmingham Union.....<br>Great Western .....<br>Bristol and Exeter .....<br>Cheltenham and Great Western Union<br>Southampton.....<br>Portsmouth Junction .....<br>South Western .....<br>London, Exeter, and Falmouth.....<br>Brighton (Stephenson).....<br>Greenwich .....<br>Croydon.....<br>Brighton (direct) .....<br>Brighton (Gibbs's) .....<br>South-Eastern .....<br>South-Eastern and Brighton.. ..<br>South-Eastern and Canterbury ....<br>Kent ..... | 1 65           | 1 29                          | 3 16            | 1 51          | 1 48                        | 1 26                  | 4 48           | 3 11                 |
| Paddington, by Grand Junction Canal Basin .....     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2 60           | 1 67                          | 4 26            | 3 18          | 56                          | 3 29                  | 5 58           | 4 40                 |
| Nine Elms-lane, Vauxhall.....                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1 77           | 2 71                          | 3 09            | 3 18          | 3 53                        | 4 33                  | 4 27           | 1 43                 |
| Joiner's-street, Southwark, near London Bridge..... |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2 36           | 3 65                          | 52              | 1 48          | 5 20                        | 2 34                  | 1 68           | 1 03                 |
| Kennington Oval.....                                | Brighton (without a tunnel) .....<br>Brighton (Gibbs) .....<br>Eastern Counties .....<br>Blackwall .....<br>London Grand Junction .....<br>Birmingham, Bristol, & Thames Junction<br>Northern and Eastern .....<br>City and Richmond .....<br>Westminster Bridge and Deptford ..                                                                                                                                                                                                                                                     | 2 11           | 3 05                          | 2 58            | 3 07          | 3 69                        | 4 22                  | 3 75           | 1 13                 |
| Vauxhall, near Toll-house                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1 57           | 2 51                          | 2 69            | 2 78          | 3 33                        | 4 13                  | 4 07           | 1 23                 |
| Shoreditch .....                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 3 23           | 3 34                          | 75              | 2 05          | 4 23                        | 1 51                  | 1 37           | 2 24                 |
| Lime-street, City.....                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2 15           | 2 59                          | 20              | 1 28          | 4 68                        | 2 16                  | 1 16           | 1 54                 |
| Skinners-street.....                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1 50           | 1 61                          | 58              | 30            | 3 14                        | 1 11                  | 2 10           | 1 54                 |
| Knightsbridge Green ..                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1 60           | 1 57                          | 3 66            | 2 56          | 2 10                        | 3 71                  | 5 16           | 3 34                 |
| Islington .....                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2 66           | 2 71                          | 1 63            | 1 39          | 2 77                        | 25                    | 3 15           | 2 60                 |
| Surrey side of Southwark Bridge .....               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1 62           | 2 56                          | 52              | 1 29          | 4 13                        | 1 73                  | 2 04           | 1 00                 |
| Surrey side of Westminster Bridge.....              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 60             | 1 54                          | 2 20            | 1 58          | 3 09                        | 2 55                  | 3 52           | 1 00                 |



No. II.—TABLE exhibiting the Length, Cost, Tunnelling, &amp;c., of each of the Railways, before Parliament, Session 1837.

| Nos. | TITLES.                                                                   | Length of Main Line. |       | Length of Main Line and Branches. |       | Cost of Main Line and Branches. |     | Length of Tunneling. |    | Curves under 3 of a mile' radius. | Bridges in Main and Branch Lines. | Steepest Plane in Main Line. |
|------|---------------------------------------------------------------------------|----------------------|-------|-----------------------------------|-------|---------------------------------|-----|----------------------|----|-----------------------------------|-----------------------------------|------------------------------|
|      |                                                                           | Ms.                  | Chs.  | Ms.                               | Chs.  | £                               | Ms. | Chs.                 |    |                                   |                                   |                              |
| 1    | Bath and Weymouth .....                                                   | 60                   | 63    | 118                               | 52.50 | 771,000                         | 6   | 26.50                | 10 |                                   | 167                               | 1 in 89                      |
| 2    | Birkenhead and Chester .....                                              | 14                   | 71.75 |                                   |       | 250,000                         | 0   | 15.90                |    |                                   | 35                                | 1 in 327                     |
| 3    | Birmingham, Bristol, & Thames Junction (Extension to Knightsbridge) ..... | 2                    | 62.94 |                                   |       | 105,000                         |     |                      |    |                                   |                                   | 1 in 330                     |
| 4    | Birmingham and Derby Junction .....                                       | 26                   | 36    | 48                                | 76.50 | 360,000                         |     |                      |    |                                   | 103                               | 1 in 396                     |
| 5    | Birmingham and Gloucester (Extension and Branches) .....                  |                      |       | 7                                 | 40.50 | 88,105                          |     |                      |    |                                   | 23                                | 1 in 300                     |
| 6    | Bishop Auckland and Weardale .....                                        | 16                   | 24    | 20                                | 53    | 162,954                         | 0   | 61.                  | 3  |                                   | 22                                | 1 in 174                     |
| 7    | Bolton and Preston .....                                                  | 19                   | 63.50 | 20                                | 12.50 | 349,500                         | 0   | 31.36                | 8  |                                   | 105                               | 1 in 150                     |
| 8    | Brighton, Lewes, and Newhaven. (From the South-Eastern Railway) .....     | 32                   | 03    | 41                                | 31    | 1,200,000                       | 1   | 33.18                | 2  |                                   | 86                                | 1 in 264                     |
| 9    | Bristol and Gloucester .....                                              | 20                   | 21    | 25                                | 66    | 400,000                         | 0   | 67.50                |    |                                   | 52                                | 1 in 204                     |
| 10   | Cheltenham, Oxford, and London and Birmingham Union .....                 | 66                   | 76    | 71                                | 05.50 | 1,400,000                       | 0   | 79.75                | 2  |                                   | 235                               | 1 in 30                      |
| 11   | Chester Junction .....                                                    | 15                   | 22    |                                   |       | 370,000                         | 0   | 14.72                |    |                                   |                                   | 1 in 438                     |
| 12   | Chester and Crewe .....                                                   | 20                   | 52.50 |                                   |       | 240,000                         |     |                      | 1  |                                   | 45                                | 1 in 396                     |
| 13   | Clarence and Hartlepool Junction .....                                    | 8                    | 33.93 | 9                                 | 65.95 | 40,000                          |     |                      | 1  |                                   | 13                                | 1 in 479                     |
| 14   | Clarence and Hartlepool Union (Great North of England) .....              | 7                    | 75    | 9                                 | 18    | 51,099                          |     |                      | 5  |                                   | 13                                | 1 in 42                      |
| 15   | Commercial (London)—Extension to Lime-street .....                        |                      | 30.75 |                                   |       | 296,400                         |     |                      |    |                                   | Viaduct                           | 1 in 340                     |
| 16   | Devizes and Melksham [excluding inclined plane at Devizes] .....          | 6                    | 73.50 |                                   |       | 55,000                          |     |                      | 2  |                                   | 8                                 | 1 in 169                     |
| 17   | Durham Junction .....                                                     | 4                    | 70.45 | 5                                 | 45.45 | 63,530                          |     |                      | 3  |                                   | 25                                | 1 in 330                     |
| 18   | Durham and Sunderland .....                                               | 3                    | 18.27 | 8                                 | 43.52 | 79,597                          |     |                      | 4  |                                   | 21                                | 1 in 110                     |
| 19   | Eastern Counties (London and Norwich) Diversions .....                    |                      |       |                                   |       | 193,900                         |     |                      |    |                                   |                                   |                              |
| 20   | Exeter and Falmouth .....                                                 | 98                   | 59    | 107                               | 02.50 | 1,700,000                       | 2   | 11.75                | 18 |                                   | 207                               | 1 in 103                     |
| 21   | Grand Connexion (Worcester and Wolverhampton) .....                       | 35                   | 56.75 | 38                                | 09    | 820,000                         | 0   | 26                   | 4  |                                   | 136                               | 1 in 83                      |
| 22   | Great North of England (Castle Eden, &c.) Extension to York, &c..         | 41                   | 46.70 | 44                                | 19.70 | 450,995                         |     |                      |    |                                   | 61                                | 1 in 384                     |
| 23   | Great Western (Paddington Extension) .....                                | 4                    | 44    |                                   |       | 250,000                         |     |                      | 1  |                                   |                                   |                              |
| 24   | Great Western Diversions (Trowbridge, &c.) .....                          |                      |       |                                   |       | 15,000                          |     |                      |    |                                   |                                   |                              |



|    |                                                                        |    |       |     |       |           |   |       |   |     |           |
|----|------------------------------------------------------------------------|----|-------|-----|-------|-----------|---|-------|---|-----|-----------|
| 25 | Kent (Deptford and Dover).....                                         | 70 | 11    | 89  | 27    | 3,000,000 | 1 | 29.72 | 2 | 249 | 1 in 155  |
| 26 | Lancaster and Preston .....                                            | 20 | 38.25 |     |       | 250,000   |   |       | 2 | 53  | 1 in 125  |
| 27 | London and Brighton, (direct) from the Croydon Railway .....           | 41 | 59    | 72  | 50    | 1,200,000 | 1 | 32.04 | 5 | 109 | 1 in 264  |
| 28 | London and Brighton (Stephenson's), from the Southampton Railway ..... | 50 | 00    | 51  | 62    | 1,000,000 | 0 | 48.72 |   | 139 | 1 in 330  |
| 29 | London and Brighton (without a tunnel) .....                           | 55 | 41    |     |       | 996,053   |   |       |   | 137 | 1 in 330  |
| 30 | London & Brighton (Gibbs), from Croydon and Branch to Vauxhall. ..     | 45 | 10.50 | 53  | 50.50 | 950,000   | 3 | 22.25 |   | 144 | 1 in 44   |
| 31 | London and Exeter (from Gillingham) .....                              |    |       |     |       | 950,000   |   |       |   |     |           |
| 32 | London and Southampton (Diversions) .....                              |    |       | 19  | 6.50  | 400,000   |   |       | 1 |     | 1 in 250  |
| 33 | Manchester and South Union .....                                       | 71 | 46    | 97  | 28.50 | 2,000,000 | 0 | 34    |   | 464 | 1 in 264  |
| 34 | Manchester and Leeds (Diversions) .....                                | 36 | 40    |     |       | 185,000   | 1 | 69.31 |   | 178 | 1 in 164  |
| 35 | Manchester & Bolton (Branch to the Manchester & Liverpool Railway) ..  | 1  | 78.56 |     |       | 24,056    |   |       | 2 |     | 1 in 600  |
| 36 | Manchester, Cheshire, and Staffordshire .....                          | 50 | 71    | 92  | 11    | 1,560,000 | 1 | 25    | 6 | 256 | 1 in 377  |
| 37 | Maryport and Carlisle (single line) .....                              | 28 | 1     |     |       | 180,000   |   |       | 6 | 73  | 1 in 208  |
| 38 | Midland Counties (Extension and Branches) ..                           | 22 | 50    | 38  | 24    | 400,000   | 0 | 67.27 | 3 | 63+ | 1 in 290  |
| 39 | North Midland (Leeds and Derby)—Diversions and Branches ..             | 15 | 58.25 | 15  | 58.25 | 75,000    | 0 | 37.50 | 4 |     | 1 in 328  |
| 40 | Oxford and Great Western Union .....                                   | 9  | 51    | 11  | 29.50 | 100,000   |   |       | 3 | 24  | 1 in 1274 |
| 41 | Portsmouth Junction .....                                              | 18 | 55.75 |     |       | 300,000   |   |       | 1 | 33  | 1 in 243  |
| 42 | Preston and Wyre (Diversions) * .....                                  | 2  | 77.25 |     |       |           |   |       |   |     |           |
| 43 | Sheffield and Manchester .....                                         | 40 | 66    | 43  | 30.50 | 700,000   | 2 | 76    | 3 | 102 | 1 in 120  |
| 44 | South-Eastern, Ashford and Canterbury .....                            | 13 | 66    |     |       | 225,000   | 0 | 11.50 | 1 |     | 1 in 330  |
| 45 | South-Eastern (Croydon and Dover.) Oxted and Godstone Diversions ..    |    |       | 25  | 46.28 | 275,000   | 2 | 50.90 |   | 49  | 1 in 264  |
| 46 | South Midland Counties (Courtenhall, &c.) ....                         | 33 | 61.75 | 60  | 30.75 | 1,100,000 | 0 | 20    | 4 | 102 | 1 in 264  |
| 47 | South-Western (Kingsworthy, &c.) .....                                 | 87 | 37    | 110 | 07    | 1,650,000 | 1 | 5.72  |   | 233 | 1 in 237  |
| 48 | Southwark and Hammersmith (known as the City and Richmond) ..          | 6  | 00    |     |       | 1850,490  |   |       |   |     | 1 in 220  |

\* To be executed within the Company's present capital.

† In extension.



## No. III.—RAILWAYS PROJECTED 1836-37, ABANDONED FOR THE PRESENT SESSION.

| Nos. | TITLES.                                                         | Length of Main Line and Branches. |       | Length of Tunneling. | Curves under $\frac{1}{2}$ of a mile' radius. | Steepest Inclination, Main Line | Bridges, aqueducts &c. |
|------|-----------------------------------------------------------------|-----------------------------------|-------|----------------------|-----------------------------------------------|---------------------------------|------------------------|
|      |                                                                 | Ms.                               | Chs.  |                      |                                               |                                 |                        |
| 1    | Birmingham, Dudley, Stourbridge, and Wolverhampton . . . . .    | 17                                | 76·75 | 1947                 | 2                                             | 1 in 154                        | 75                     |
| 2    | Brecon and Merthyr Tydvil . . . . .                             | 19                                | 23    |                      | Several                                       | 1 in 22                         |                        |
| 3    | Central Kent . . . . .                                          | 80                                | 55    |                      | 3                                             | 1 in 269                        | 174                    |
| 4    | Colliers' Wharfs' Railway . . . . .                             | 2                                 | 72    |                      | 2                                             | 1 in 60                         | Viaduct                |
| 5    | Doncaster, North Midland, and Goole . . . . .                   | 27                                | 15·50 | 236                  | 2                                             | 1 in 416                        | 33                     |
| 6    | England and Ireland Union . . . . .                             | 80                                | 18    | 3505                 | 2                                             | 1 in 50                         | 177                    |
| 7    | Glastonbury and Bruton . . . . .                                | 17                                | 69    |                      | Several                                       | 1 in 27                         | 15                     |
| 8    | Gloucester and Bristol . . . . .                                | 29                                | 14·83 |                      | 2                                             | 1 in 300                        | 166                    |
| 9    | Hants and Wilts Union . . . . .                                 | 21                                | 71    |                      | 2                                             | 1 in 228                        | 45                     |
| 10   | Harwich . . . . .                                               | 17                                | 30·50 |                      |                                               | 1 in 391                        | 26                     |
| 11   | Hyde Park and Richmond . . . . .                                | 8                                 | 59·84 |                      |                                               | 1 in 300                        | 25                     |
| 12   | Ipswich and Bury St. Edmunds . . . . .                          | 24                                | 09·   | 2200                 | 4                                             | 1 in 342                        | 34                     |
| 13   | Ireland, South Wales, Gloucester, Cheltenham, & London Junction | 44                                | 40    | 2062                 | 1                                             | 1 in 40                         | 75                     |
| 14   | London and Penge . . . . .                                      | 7                                 | 21·72 |                      |                                               | 1 in 253                        | 15                     |
| 15   | London, Rochester, and Chatham . . . . .                        | 14                                | 08·   |                      | 1                                             | 1 in 352                        | 24                     |
| 16   | Manchester Connexion . . . . .                                  | 2                                 | 8·90  |                      | 4                                             | 1 in 50                         | Viaduct.               |
| 17   | Northern and Eastern . . . . .                                  | 146                               | 23    |                      |                                               | 1 in 528                        | 256                    |
| 18   | St. George's Harbour Railway . . . . .                          | 65                                | 10    | 2838                 | 1                                             | 1 in 415                        | 116                    |
| 19   | Salisbury, Romsey, and Southampton . . . . .                    | 23                                |       |                      | 3                                             | 1 in 480                        | 83                     |
| 20   | South-Eastern and Maidstone . . . . .                           | 11                                | 57·50 |                      |                                               | 1 in 432                        | 50                     |
| 21   | Stafford and Rugby . . . . .                                    | 51                                | 15·75 | 940½                 | 2                                             | 1 in 330                        | 89                     |
| 22   | Stourbridge and Dudley . . . . .                                | 14                                | 43    | 1298                 | 3                                             | 1 in 30                         | 58                     |
| 23   | Taw Vale . . . . .                                              | 3                                 | 28    | 352                  | 2                                             | Level                           |                        |
| 24   | Truro, Redruth, and Penzance . . . . .                          | 26                                | 54    |                      | 12                                            | 1 in 43                         |                        |
| 25   | Warwick, Leamington, and Coventry Junction . . . . .            | 9                                 | 56    |                      | 2                                             | 1 in 120                        | 20                     |
| 26   | Weardale Junction, or New South Durham . . . . .                | 16                                | 09·25 |                      | 8                                             | 1 in 14·20                      | 19                     |
| 27   | West Durham . . . . .                                           | 11                                | 74·90 |                      | 6                                             | 1 in 38·73                      | 20                     |



## SUMMARY.

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The number of proposed Railways, including Diversions, Extensions, and Branches, in England and Wales, for which plans have been lodged in the Private Bill Office in the present Session, is seventy-five, of which only forty-eight are under the consideration of Parliament; these amount in length to twelve hundred and thirty-three miles, and are estimated at the sum of Nineteen Millions Three Hundred and Fifty-two Thousands Seven Hundred and Twenty-six Pounds,\* or Fifteen Thousand Six Hundred and Ninety-five Pounds per mile. The whole length of tunnelling is twenty-five miles; and the number of bridges, exclusive of viaducts and culverts, two thousand eight hundred and twenty-five, or nearly two and a third per mile. The weight of iron required for the Rails, is one hundred and ninety-three thousand five hundred tons; and of stone for the blocks, two millions six hundred and seventy thousand tons. The area of land required to be taken is upwards of fifteen thousand acres; and of felt for the chairs, one hundred and thirty acres. These Railways, if carried into execution, would employ at least five thousand men and fifteen hundred horses for three years.† The principal competing lines are the five Brighton, the two Birkenhead and Chester, and the South Union, and Manchester Cheshire and Staffordshire Railways.

The proposed Railways, in England and Wales, abandoned in the present Session, are twenty-seven in number, amounting in length to seven hundred and ninety-four miles; the length of tunnelling is about eight and three-quarter miles; and the number of bridges one thousand five hundred and ninety-five, or about two per mile

\* This sum is exclusive of four of the proposed Brighton lines, one of the Southern lines from Manchester, one of the Birkenhead and Chester lines, the Great Western, Southampton, North Midland, and Eastern Counties' Diversions; and also the line from Gillingham to Exeter.

† For the earthworks alone.



## No. IV.—RAILWAYS IN ENGLAND AND WALES, for which Acts were obtained in the Session of 1836.

| Nos. | TITLES.                                             | Capitals.    | Received the Royal Assent |
|------|-----------------------------------------------------|--------------|---------------------------|
| 1    | Aylesbury .....                                     | £.<br>50,000 | May 19.                   |
| 2    | Birmingham, Bristol, and Thames Junction .....      | 150,000      | June 21.                  |
| 3    | Birmingham and Derby .....                          | 530,000      | May 19.                   |
| 4    | Birmingham and Gloucester .....                     | 945,000      | April 29.                 |
| 5    | Bolton and Leigh .....                              | 3,400        | May 20.                   |
| 6    | Brandling .....                                     | 97,000       | June 7.                   |
| 7    | Bristol and Exeter .....                            | 1,400,800    | May 19.                   |
| 8    | Cheltenham and Great Western .....                  | 750,000      | June 21.                  |
| 9    | Deptford .....                                      | 60,000       | June 21.                  |
| 10   | Gateshead and Durham (Great North of England) ..... | 660,000      | July 4.                   |
| 11   | Hayle .....                                         | 93,000       | July 4.                   |
| 12   | Hull and Selby .....                                | 485,000      | June 21.                  |
| 13   | Leeds and Derby (North Midland) .....               | 1,500,000    | July 4.                   |
| 14   | London and Blackwall (Commercial) .....             | 100,000      | July 28.                  |
| 15   | London and Cambridge .....                          | 1,200,000    | July 4.                   |
| 16   | London and Dover (South Eastern) .....              | 1,400,000    | June 21.                  |
| 17   | London and Norwich (Eastern Counties) .....         | 1,500,000    | July 4.                   |
| 18   | London Grand Junction .....                         | 600,000      | July 4.                   |
| 19   | Manchester and Leeds .....                          | 1,300,000    | July 4.                   |
| 20   | Merthyr Tydvil and Cardiff .....                    | 300,000      | June 21.                  |
| 21   | Midland Counties .....                              | 1,200,000    | June 21.                  |
| 22   | Newcastle and North Shields .....                   | 120,000      | June 21.                  |
| 23   | Preston and Longridge .....                         | 30,000       | July 4.                   |
| 24   | Sheffield and Rotheram .....                        | 90,000       | July 4.                   |
| 25   | Thames Haven .....                                  | 450,000      | July 4.                   |
| 26   | York and North Midland .....                        | 370,000      | June 21.                  |
|      |                                                     | £15,384,200  |                           |



## DETAILED ESTIMATE.

ESTIMATE OF THE PROPOSED HERTFORDSHIRE GRAND UNION  
RAILWAY.

|                                                                                                                                               | £. s. d.          | £. s. d.              |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------|
| Earthworks .....                                                                                                                              |                   | 74,584 13 0           |
| Formation of way, viz. rails 50lbs. per lineal yard<br>for single way, $78\frac{1}{2}$ tons per mile, £12. ....                               | 942 0 0           |                       |
| Chairs, 18lb. each, one at every yard, under each<br>rail, gives 3520 chairs, at $28\frac{1}{2}$ tons per mile for<br>single way, at £10..... | 285 0 0           |                       |
| Keys, Pins, &c., 5lbs. per yard for single way,<br>gives 390 tons per mile, at £18. 18s. per ton ..                                           | 73 14 0           |                       |
| Felt, 3520 pieces, at $\frac{1}{2}d$ .....                                                                                                    | 7 6 0             |                       |
| Blocks or Sleepers, 3520 at 4s. ....                                                                                                          | 704 0 0           |                       |
| Ballasting and laying the road, including drainage,<br>1760 yards lineal at 5s. ....                                                          | 440 0 0           |                       |
|                                                                                                                                               | <u>£2,452 0 0</u> |                       |
| Length of Line..... $26\frac{1}{2}$ miles.<br>add sidings 240 yards lineal per<br>mile, gives..... $3\frac{1}{2}$<br>together..... 30 miles.  |                   |                       |
| And 30 miles at £2452 .....                                                                                                                   |                   | 73,560 0 0            |
| Fencing 2s. $1\frac{1}{2}d$ . per lineal yard, or £374. per<br>mile for $26\frac{1}{2}$ miles, is.....                                        |                   | 9,911 0 0             |
| Depôts .....                                                                                                                                  |                   | 10,000 0 0            |
| Brickwork and Masonry and Level Crossings ..                                                                                                  |                   | 21,500 0 0            |
|                                                                                                                                               |                   | <u>£.189,555 13 0</u> |
| Contingencies, 10 % cent .....                                                                                                                |                   | 18,955 0 0            |
|                                                                                                                                               |                   | <u>£.208,510 13 0</u> |
| Approximate value of Land and Buildings ....                                                                                                  |                   | 29,055 0 0            |
|                                                                                                                                               |                   | <u>£.237,565 13 0</u> |

(Signed)

FRANCIS WHISHAW,

Civil Engineer.

GRAY'S INN,

December, 1836.



## GLOSSARY.

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### ARCHITECTURE.

Architecture should form an important part of the education of every engineer ; without a knowledge of this art, his designs will often be crude and unmeaning. There are many situations in every public railway, where a little architectural display is absolutely necessary. In passing through a park, or in entering a city, he will find his knowledge of architecture of great service.

### ARCH.

Arches of every variety are required in a long line of railway—the semicircular, the segmental, and the semi-elliptical, each is required in turn, according to the position of the road, canal, or river to be crossed, and the level of each respectively.

The clear height of arches for carrying roads over the Birmingham Railway is 15 feet 6 inches.

### ANGLE OF REPOSE.

A plane is said to be formed at the angle of repose, when an engine will stand on that plane without its wheels slipping ; this is the case when the gravity and friction of the train are equal—thus, a plane inclining at the rate of 1 in 280, or 18 feet 10 inches per mile, is at the angle of repose, if the friction of a ton on a level be taken at 8lbs., or if it be taken at 7lbs., then the angle of repose applies to an inclination of 1 in 320, or 16 feet 6 inches per mile.

### AQUEDUCT.

Until railways were introduced, aqueducts were chiefly required in England for the passage of canals over vallies, rivers, and roads ;



the famous aqueducts in North Wales of the celebrated Telford, present two of the first examples of modern times. Where the height of the canal or river above the railway will allow of it, brick or stone arches may be introduced; but in case the height is limited to 10 or 12 feet, the introduction of a tank formed of cast iron plates, bolted and cemented together, and supported on ribs of the same material, will be found effectual.

### BALLASTING.

When the embankments and cuttings of a railway are finished, the next operation is to overlay them with gravel, broken granite, or other hard stone, for a thickness of two feet; this is called ballasting the way. In coal districts the ballasting is often a layer of small coal.

### BATTLEMENT.

In Lancashire this term is used for the parapet of a bridge.

### BENCH.

In deep cuttings a bench or level stage is formed, three or four feet wide, where a change from one slope to another is required, on account of the difference of strata; tile drains, with frequent perforations, may often be introduced half way down a cutting in these benches with great advantage: thus saving the lower part of the slope from gullies, which might otherwise be formed by the surface water descending to the bottom of the cutting.

### BELL.

Many of the engines on the Stockton and Darlington Railway are furnished each with a bell, which the engine-man rings to give notice of his approaching a station, or of the time for starting a train; but this system has been superseded on the Newcastle and other public railways, by the steam whistle, which produces a shrill sound, but so loud as to be heard at a great distance.

### BLOCK.

Blocks of granite or hard stone are chiefly used in cuttings, as foundations for the rails; they are not usually placed on embank-



ments, till the full amount of subsidence has taken place, which varies with each particular soil.

The blocks on the Birmingham and Greenwich Railways contain each four cubic feet ; on the former they are set diagonally, at a distance from middle to middle of three feet, where the 50lb.-rails are used ; but where the 75lb.-rails are adopted, the distance is four feet.

On parts of the Leeds and Selby Railway, a continuous line of stone blocks is placed under each rail, 16 inches in width, one foot deep, and in lengths of three feet ; the four lines are kept together by iron ties running from one side to the other.

A somewhat similar plan is adopted on the Bolton and Preston Railway, with this difference, that the blocks are five feet in length, two feet wide, and bedded upon brick sleepers, and the iron ties are dispensed with.

### BRICKS.

Since the introduction of railways, the consumption of bricks for the bridges and culverts, in districts where stone is expensive, has been immense. The Greenwich Viaduct, and the tunnels, together with a great proportion of the bridges on the Birmingham Railway, are constructed almost entirely of brickwork.

The most durable bricks are the Stocks of London, and Manchester ; the most perfect in form and color those from Suffolk ; and the softest and most porous are made in the Midland Counties of England.

The cost of brickwork at present is rather more than half the value of stone, in districts where the latter is abundant. In London, brickwork is measured by the rod, which is equal to 306 cubic feet ; in Lancashire, it is customary to measure brickwork by the cubic yard. There are  $11\frac{1}{2}$  yards in a rod.

### BREAKING GROUND

Is used to express the commencement of railway operations.

### BRIDGE.

Bridges for railways are constructed of brick, stone, timber, and iron. On the Manchester and Liverpool line, each of these materials is used in turn. The neatest bridge on this line carries the Saint Helen's Railway over the former ; it is con-



structed of cast iron columns, supporting an entablature of the same material; the effect of the whole is striking.

On the Manchester and Bolton Railway, where little height exists between the level of the rails and the roads passing over it, Mr. Hartley, the engineer, has separated the two lines of way by iron columns, thus shortening the bearings, and enabling him to give the least practicable depth to the road bearers, and the greatest possible height for the passage of the locomotives.

The bridge, carrying the Edgware-road over the Birmingham Railway, is constructed of iron springing plates, with intermediate arches of brick, built in cement.

On the Southampton Railway, some of the bridges are constructed of cast iron girders, supporting Yorkshire stone landings; but the objection to this method is, the difficulty of making water-tight joints.

The bridge at present erecting, to carry the North Union Railway over the river Weaver, at Preston, under Mr. Vignoles' direction, is entirely of stone, and consists of five semi-elliptical arches, each of 140 feet span.

One of the most elegant railway bridges which has, as yet, been erected, is that on the line of the Birmingham Railway, at Rugby; it is constructed of cast iron, and the whole is designed, in the style of architecture characterizing the buildings of Rugby School.

The number of bridges required for a railway varies in almost every instance: on the Manchester and Liverpool line, there are about two in a mile, exclusive of the viaducts; on the Leeds and Selby Railway, the proportion is about  $2\frac{1}{8}$  bridges per mile.

In the projected Railways now before Parliament, there are  $2\frac{1}{3}$  bridges in a mile.

### BUFFING APPARATUS.

This is a sort of spring carriage attached to railway vehicles to prevent the unpleasant shock to passengers, occasioned by the sudden stopping of a train; it also prevents injury to the carriages.

The machine for this purpose used on the Dublin Railway is constructed of longitudinal spiral springs, and is altogether on the most approved principle.

### CARRIAGE.

The carriages used on railways are built in a variety of forms; the most approved are the first class carriages on the Manchester



and Liverpool Railway, which are divided into three compartments, each containing ample room for six persons ; the extreme length of each is 14 feet, and the width 7 feet. The night trains are furnished with patent lamps.

The second class carriages are open at the sides and have seats for 24 persons.

The Stockton and Darlington Railway carriages are divided into three compartments ; the middle one is closed and the other two are open ; the extreme width is 5 feet 9 inches, the internal height 4 feet 8 inches, and the width of each seat 16 inches ; the wheels are four in number, and 2 feet 7 inches in diameter.

Some of the carriages on the Greenwich Railway are of the size usually adopted, but are without the divisions, having seats all round, except where the doors intervene.

### CHAIR.

A chair or pedestal forms the medium by which the rail is attached to the stone block, or wooden sleeper ; it is made of cast iron, and for a 35lb.-rail, weighs about 13lbs., for one of 50lbs. per yard, 18lbs., and so on. The simplest form is such as is used on the Leicester and Swannington and Greenwich Railways, 9 inches in length by  $4\frac{1}{2}$  inches wide, furnished with an upright socket in which the rail rests ; the mode of securing the rail to the chair, is by means of a wedge driven in between the rail and one side of the socket. On the Birmingham Railway, the new rails are keyed in with oak wedges ; the base of the chair has two perforations, through each of which a spike is driven to secure the chair to the block or sleeper. The pedestals on the Manchester and Bolton Railway are 14 inches in length, 6 inches wide, and  $1\frac{1}{4}$  inches thick, with a slight sinking in the direction of the rail, each having six perforations three-quarters of an inch in diameter, two of which are required for the screw bolts, securing the pedestal to the stone, and the rest for those securing the rail to the pedestal ; the latter operation is performed by placing the rail between the four screw bolts driven into the stone, and securing the flanch of the rail by sexagonal nuts screwed down to the top thereof.

### CHIMNEY.

The height from the rail to the top of the chimnies of the most approved engines on the Leicester and Swannington and Newcastle Railways, is 12 feet.



## COAL WAGGON.

The waggons used on the Stockton and Darlington Railway, are made chiefly of sheet-iron, with a foundation of wood; the shape is that of an inverted truncated pyramid; the top length is 8 feet by 6 feet in width, and the bottom length 4 feet by 4 feet in width, the height is 3 feet 9 inches, the wheels are four in number, and each 2 feet 9 inches in diameter; the gross weight is about 53 cwt.

The Leicester and Swannington Railway waggons are on the most approved construction; the foundation consists of longitudinal and cross bearers of wood, and the body of cast iron plates bolted together through the medium of flanches; the length at top is 9 feet, the width 6 feet 4 inches, and the height 18 inches, the ends are sloped inwards, the whole is hung on springs, which are on the outside of the wheels. The cost of such a waggon is about £50.

On the Newton and Warrington Railway, the bodies of the coal waggons are suited both for railway and common road carriages. This method saves considerable labor and expense.

## COWL.

The cowls used for locomotive engine chimnies, are constructed of strong wire gauze; in shape they are semi-globular; the intention is to prevent flakes of fire escaping from the chimnies.

On the Newcastle and Carlisle Railway, they have been used for a time, but with so little good effect, that they are now entirely disused.

## CULVERT.

A large drain, either of brick or stone, used in railways for passing brooks and streams under the embankments. The size of a culvert must be determined by the area of a vertical cross section, taken in the time of flood, from which it will be easy to calculate the quantity of water required to pass through it.

## CURVES.

Quick curves in a railway limit the speed of the engines; at high velocities the tendency of the wheels is to pursue a direct course, instead of following the line of the curve. In order to annul this effect to a certain degree, engineers have added conical



tires to the engine's wheels, which allows the opposite pairs to run in curves of different radii; and, as another means of preventing the wheels from dragging on the outer rail, by reason of the centrifugal force, a certain amount of elevation is given to the outer rail, varying with the radius of curvature, which brings in the aid of gravity to counteract the effect of the opposing agent.

In public railways, curves under three-quarters of a mile' radius should be avoided. On the Manchester and Liverpool Railway the least radius of curvature is 13 chains; and on the Leeds and Selby Railway half a mile.

On the Newcastle and Carlisle Railway there are several curves of about a quarter of a mile' radius.

The plans of most of the proposed public railways now under the consideration of Parliament, present comparatively few curves of small radius.

#### DATUM.

The datum is a perfectly horizontal line drawn on railway sections, from which the heights or depths of the planes are measured, and to which all the levels refer.

By one of the new Standing Orders, it is required that the datum shall refer to some fixed mark, which must be expressed in the section.

The datum for sections taken in the neighbourhood of London, is usually the Trinity high-water level, fixed in London in the year 1800.

It is very desirable that one datum should be fixed for the whole of England and Wales.

#### DRAIN.

Drains are built of all shapes and sizes, from 9 inches to 2 feet in diameter, some with inverted arches and others with vertical side-walls: they are much required in all railway works. Besides those built of brick or stone, tile-drains are much used, running along the bottom of cuttings, to take off the surface-water, which in amount is proportioned to the length of the slope.

On the Clarence Railway, open drains are dug parallel with the top lines of cuttings, which prevents the water forming gullies in the slopes; and, as a further preventive, sloping tile-drains, or wooden troughs, are made to communicate from the top drains to those at the bottom of the slopes.



An open drain is formed parallel, and at the bottom of every embankment: the soil excavated forms a bank for the quick hedge.

### EARTHWORK.

This term applies to the excavations, embankments, formation of new roads over or under a railway, the open drains, and the removal of the soil for the foundations of bridges and other erections.

### EDGE RAIL.

The edge rail has now entirely superseded the tram or train-plate, and is used in all railways worked by locomotive engines. This form of rail causes much less friction to the wheels, there being considerably less surface of the former coming in contact with the latter.

These rails are made of wrought iron, in 15-foot lengths, with an upper flanch slightly curving from the middle to the sides; the weight of rail is regulated by the tonnage passing along the line.

On the Stockton and Darlington, Manchester and Liverpool, and Leeds and Selby Railways, the weight per lineal yard of the original rails is 35lbs. On the Manchester Railway, however, rails of 75lbs. have been substituted. The size of the 35lb. rail is  $3\frac{1}{2}$  inches in depth,  $2\frac{1}{4}$  inches as to the width of the upper flanch, and the upright portion three-quarters of an inch thick.

The original rails of the London and Birmingham Railway are 50lbs. in weight, as also those of the Greenwich Railway; but on the former line 75lb. rails are being laid down to a considerable extent.

The Manchester and Bolton rail weighs 50lb. to the yard: the top flanch is  $2\frac{1}{4}$  inches wide, the bottom flanch  $4\frac{5}{8}$  inches wide, the depth  $2\frac{9}{10}$  inches, and the thickness of the middle portion three-quarters of an inch. The Croydon rail is similar in shape, but different in dimensions. The Great Western is of the most improved form, presenting a large bearing surface, being 6 inches in width at its base, and weighing only 43lbs. per yard.

### EMBANKMENT

Is a mound of earth, raised for the purpose of carrying a railway across a valley or low ground. Embankments are usually formed from the excavations made in the higher portions of the ground in the line of railway; but when cuttings are remote from the parts to be embanked, or in case of a deficiency of material, it becomes



necessary to resort to what is called side-cutting. The embankment contiguous to the Sankey Viaduct, on the Manchester and Liverpool Railway, was partly formed from side-cutting; this increases the area of land to be taken, but lessens the expense of the carriage of the material.

The greatest quantity which can be teamed over an embankment in one year, is allowed, by experienced engineers, to amount to from 230,000 to 250,000 cubic yards.

Some of the highest embankments, as yet formed, are on the Clarence Railway.

The Broad Green embankment, on the Manchester and Liverpool Railway, is nearly 3 miles in length, varying in breadth at the base from 60 to 135 feet, and averaging 30 feet in height; the total quantity of material is 550,000 cubic yards.

In order to give some notion of the immense increase in the bulk of an embankment by augmenting the slopes, the following particulars will be useful:—

An embankment 30 feet high, one chain, or 66 feet in length, with slopes of three-quarters to one, and the top of embankment 33 feet in width, contains 4070 cubic yards; with slopes of 1 to 1, 4620 cubic yards; with slopes of  $1\frac{1}{2}$  to 1, 5871 cubic yards; and, lastly, with slopes of 2 to 1, 6820 cubic yards.

### EXCAVATION.

This is an operation of cutting down the high portions of the ground in the line of a railway, in order to obtain the inclinations designed by the engineer: the soil excavated goes to form the embankments; if these are too far off, it goes to spoil, or is placed in large heaps at the side of the railway. The value of the land, and the length of the lead to the embankments, are necessary elements in the calculation, as to which is the most preferable plan to be adopted. Much more work may be performed in a cutting than in an embankment, in a given time, because the operations may be going on at several places at the same time, and more lines of temporary railway may be laid down.

The Olive Mount excavation on the Manchester and Liverpool Railway, was effected by the removal of 480,000 cubic yards of sand-stone rock, which to a great extent was used in the neighbouring bridges; the sides of this cutting are perpendicular. A cutting in solid chalk may be effected with slopes of one-sixth to one, that is, for every yard in height, the side of the cutting inclines six inches. A good example of chalk cutting is presented in the



great excavation formed between the two tunnels on the Thames and Medway Canal.

#### FELT.

The manufacture of felt has wonderfully increased since its application to railways has become general. It is cut into squares corresponding with the size of the chair, and forms a compact medium between the under surface of the iron chair, and the upper surface of the stone block. The number of pieces of felt required for a mile of double-way is 7040. Where wooden sleepers are used, this article is not required.

#### FENCING.

The fencing of railways varies in each particular district; the post and rail fence, however, is the most common: where stone is easily obtained, and labour is cheap, it is to be preferred to wooden fencing.

The Stockton and Darlington Railway is to a considerable extent fenced in with neat hedge-rows. Brick walls have been adopted on the Greenwich Railway.

#### FRICTION.

The friction of well-constructed carriages on railways is found, from the many valuable experiments made on the Manchester and Liverpool Railway, and other lines, to amount to from 7 to 8lbs. per ton.

A train, therefore, of 60 tons, on a level, will require the engine leading it to exert a power of 420lbs. if the former be taken as the *maximum*, or 480lbs. if the latter.

#### FUEL.

The fuel mostly used for locomotive engines is coke. On the Manchester and Liverpool Railway, this article is of the best quality; the quantity consumed is about five-sixths of a lb. per ton per mile, so that a train of 60 tons gross, travelling a distance of 100 miles, requires a consumption of nearly  $2\frac{1}{4}$  tons.

On the Clarence and Leicester and Swannington Railways coal is substituted, but for passenger-ways this article is now entirely prohibited.

#### GALLERY.

This is a term used for a tunnel worked from side shafts instead of vertical shafts: thus in the South-Eastern Railway, it is intended



to form galleries through the cliffs at Dover, leaving the shafts open as so many port-holes, to afford light and ventilation.

### GRADIENT.

This term is used to express the proportion of ascent or descent in a mile; thus, an inclined plane which is five miles in length, and rises 45 feet, is said to be laid out with a gradient of 9 feet.

### GRAVITY

Is the agent which operates so powerfully in rendering inclined planes on railways so objectionable; on a level plane, the only resistance to the motion of the train, if the effect of wind be not taken into the account, is from 7lbs. to 8lbs. per ton for the friction, but on an ascent of 1 in 50, the resistance by gravity is 44.80 lbs. for each ton; for 1 in 90, it is 24.88lbs. per ton, which, on a train of 60 tons gross, amounts to 1493lbs.; this is the additional power to be exercised by the engine, which renders the train equal to 186 tons on a level; it is evident, then, that an engine and load ascending such a plane, in order to preserve the same velocity as on a level, will require powerful assistance.

The sad effect of steep inclinations is strikingly exemplified on the Whiston and Sutton planes of the Manchester and Liverpool Railway, where an assistant engine is required to be in constant attendance, to assist the first class trains in making their ascent.

On the Clarence, Canterbury and Whitstable, Stockton and Darlington, and Leicester and Swannington lines, the trains descend some of the planes entirely by gravity.

### GUAGE OF WAY.

This is the clear width between the top flanches or rims of the rails: the guage hitherto adopted on all locomotive-ways is 4 feet 8 inches, but Mr. Brunel intends to adopt a wider guage on the Great Western Railway, which will enable him to use more powerful engines, and, consequently, to increase the speed.

### HORSE POWER.

Until the introduction of the locomotive engine, horses were the chief moters on railway; on the Clarence Railway horses are



still used ; and in Cornwall, except on the Bodmin Railway, all the railways are worked by horses.

Experience has shewn that the greatest amount of continuous work which can be performed by a horse, is at a speed of from 2 to  $2\frac{1}{2}$  miles per hour, and for eight hours per day.

On the Whitby and Pickering Railway, which is a very tortuous line, and with some quick rises, horse power, with the exception of one plane, which is on the self-acting system, is entirely used ; the speed varies from seven to ten miles an hour ; the weight of the carriage being  $2\frac{3}{4}$  tons.

On the Clarence Railway, the passengers' carriage is still worked by a horse, whose average speed is about seven miles an hour.

The descent on this line being for a considerable length in one direction, the horses are relieved, on the waggon's descent, by the aid of gravity : each horse returning to the bottom of the incline, in a stable attached to the train.

On a well-constructed edge-railway, a horse with great ease can draw 10 tons gross, at from 2 to  $2\frac{1}{2}$  miles an hour, and for eight hours a day. The resistance by gravity of ten tons on a plane rising at the rate of 1 in 50, is nearly the same as that offered by sixty tons on a level.

### INCLINED PLANE.

Every plane which is not perfectly level is really an inclined plane, though some Engineers apply this term to those planes only which require stationary engines.

### INTERMEDIATE SPACE

Is the width between each pair of rails on a double line of way. On the Manchester and Liverpool Railway it is about 5 feet 8 inches ; on the Dublin and Kingstown and Leeds and Selby Railways nearly 8 feet ; on the London and Birmingham Railway 6 feet ; on the Stockton and Darlington and Clarence Railways 4 feet each.

### KEY,

Is a small wedge of iron used to secure the rail to the chair. On the London and Birmingham Railway, oak wedges have been introduced in securing the heavy rails.



## KYANIZE.

To prepare timber with Mr. Kyan's patent solution, in order to preserve it from decay. The experiments made in the pits of Woolwich Dock Yard, by order of Government, produced the most satisfactory results. It is now coming into general use for all timbers used in the upper works of railways.

## LAND.

The width of land required to be taken for a railway, except where carried on the surface of the ground, depends on the height of embankment, or depth of cutting at any point, and the width of way allowed. If the width of a double-way be taken at 11 yards, which is ample, and 2 yards be allowed on each side for the drains and fencing: the area of land required for 1 mile will be 4.72 acres per mile; and for every 10 feet in height or depth for an embankment or cutting, with slopes of 1 to 1, the whole width will be increased 20 feet, or 6.66 yards, and the whole area per mile, for the first increase of 10 feet in height or depth, will be 7.87 acres per mile, for the next 10 feet, 10.30 acres per mile, and so on.

The full width for a single way should be 18 feet.

## LEAD,

Is the distance required to be traversed by waggons used in transferring the produce of the cuttings to form the embankments. A lead of a quarter of a mile in length, enables a contractor to execute the work at about 8*d.* per cubic yard, which is about the average value of side cutting; for a lead of half a mile 10*d.*, 1 mile 12*d.*, 2 miles 14*d.*, and so on.\*

## LENGTH.

The lengths taken on railways are in miles, chains, and yards. A mile contains 80 chains, or 1760 yards, or 5280 feet; a chain is subdivided into 100 links; the fractional part of a chain may therefore be expressed decimally, as 3.75, or  $3\frac{3}{4}$  chains.

## LEVEL.

If a line be drawn between any two points which are equidistant from the centre of the earth, such line is called a level line.

\* See Addenda, page 296.



## LEVELLING.

The operation of levelling is a work in the preliminary steps of a railway, requiring the greatest possible care, for if the section produced from such levels be not very accurate, the calculation of the earthworks, the inclinations of the planes, and the estimated cost, will each be erroneous. No prudent Engineer will be content with the result of his first levels, but will have them checked from one end of the line to the other.

The facilities of levelling are greatly increased, owing to the beautiful instruments of Messrs. Troughton and Simms, and that of Mr. Gravatt, as well as by the improved reading-off staff, which enables the person levelling to view the heights on the staff at a considerable distance, thus expediting the operation, rendering it more certain, and enabling him to dispense with a tutored assistant.

## LEVEL CROSSINGS.

The crossings of turnpike-roads and highways by a railway, on the level, is now prohibited.

The accidents which have occurred from cattle straying on public railways, and the chance of injury being done to road vehicles crossing the railway at the moment of a train passing, has suggested this salutary restriction. Moreover, if a lodge, with gates, is to be erected at each level crossing, and a man constantly stationed at the spot, it is generally less expensive to build a bridge at once.

On the Manchester and Liverpool, Dublin and Kingstown, Stockton and Darlington, Newcastle and Carlisle, and other Railways, for which Acts were obtained previously to the Session of 1836, these objectionable crossings are very frequent; even on the Birmingham Railway, within twelve miles of London, there are two level crossings.

## LOCOMOTIVE PLANE.

Every plane which can be worked by locomotive engines, with or without assistance, may be termed a locomotive plane.

## LOCOMOTIVE ENGINE.

Locomotive engines of very imperfect construction were in use for a long time previously to their introduction on public railways. The Stockton and Darlington Railway is the first on which this master-



piece of human skill was introduced as a substitute for horse-power. Many of the engines still used on this line are very ponderous and clumsy, but still they are powerful. The Lord Brougham may be quoted as an example; it is an engine 16 feet in length, supported on six heavy wheels, each three being connected together by cranks: these wheels are each 4 feet in diameter; the whole weight is about 12 tons. The two cylinders are placed in front of the chimney, and are each 14 inches in diameter, the piston of each working vertically, and communicating with the cranks beneath, attached to the wheels.

On the Manchester and Liverpool Railway, the proportion of the number of engines in daily use is almost one to every three miles, and about as many more under repair: among those at present in use may be mentioned, the Collier, the Mercury, the Rapid, the Hercules, the Ajax, the Speedwell, and the Thunderer. Some of these engines were built by Messrs. Taylor and Co., of the Vulcan Foundry, near Warrington.

On the Dublin and Kingstown Railway, where the passenger-traffic is very considerable, the trains starting from either end of the line almost twenty times a day, the number of engines is nine; they are severally called, the Manchester, the Britannia, the Vauxhall, the Kingstown, the Dublin, the Comet, the Vittoria, and the Stanley. Three of these were built by Messrs. Sharp and Roberts, of Manchester, and have 11-inch cylinders and 16-inch stroke; and the remainder by Mr. Forrester, of the Vauxhall Foundry: the weight of these engines is from about 9 to 10 tons; many of them are of elegant design.

On the Leicester and Swannington Railway, where the tonnage of coal alone, from Mr. Stephenson's and other collieries, is about 500 tons a day, the number of engines is seven, viz., the Comet, the Hercules, the Goliah, the Vulcan, the Atlas, the Samson, and the Liverpool.

The Atlas and Vulcan, each with six wheels, are two of the most powerful engines at present in use on any line of railway, having cylinders of 16 inches diameter, and 20-inch stroke; they are built for heavy loads and slow speeds.

The Hercules, Goliah, and Samson, have each 14-inch cylinders, and 18-inch stroke; and, lastly, the Comet and Liverpool, 12-inch cylinders, and 14-inch stroke.

The valuable work on locomotive engines by the Chev. de Pam-bour, contains the best possible information with regard to the construction of the locomotive engine.



**OBLIQUE ARCH,**

Or, as it is commonly called, the skew arch, is rendered necessary in a line of railway, where it is not desirable to alter the course of the canal road or river to be crossed. The construction of oblique arches requires very great skill, both on the part of the engineer, in drawing out the proper developement of the several parts, and the mason in carrying the design into effect.

On the Manchester and Liverpool Railway, the arch carrying the London road over the railway, near Rainhill, is of this description: its span is 54 feet on the skew, and the angle of obliquity  $34^{\circ}$ .

In the Greenwich Railway Viaduct, there are twenty-seven skew arches; the most worthy of notice is that over Bermondsey-street, a description of which will be found at page 211 of this volume.

**OCCUPATION-ROAD.**

The number of occupation-road arches required in a line of railway, varies almost in each particular instance; the average is about two per mile. The size of an occupation arch will be sufficiently wide at 12 feet; and its height should not be less than 12 feet 6 inches.

**PLAN.**

According to the new Standing Orders of the House of Commons, all plans for railways are required to be drawn to a scale of not less than 4 inches to a mile; and the enlarged plans to a scale of not less than a quarter of an inch to 100 feet. It is astonishing that this last regulation had not been required before. In the case of the Manchester and Leeds Railway, in the Session of 1836, large plans were made of all the intricate portions of the line.

**PLANE.**

A plane, as applied to a railway, may either be level or inclined: the length of a plane is the horizontal distance from one change of inclination to another.

**PARALLEL RAIL.**

Until the publication of the valuable Report made by Professor Barlow to the Directors of the London and Birmingham Railway, the use of the parallel rail was by no means universal; even on this great work, the 50lb. rails are of the fish-bellied form, and extend over a great portion of the line. The rails of the Leeds and Selby, Greenwich, Bolton and Manchester, Clarence, Dublin and Kings-



town, and the new 75lb. rails on the Manchester and Liverpool, and London and Birmingham Railways, are all of the parallel form, while those of the Stockton and Darlington, Leicester and Swannington, and Whitby and Pickering Railways, are of the fish-bellied form.

#### RAIL—*See Parallel Rail.*

Cast iron is now wholly disused for rails; the manufacture being confined to malleable iron, which undergoes the process of rolling, to produce the required form. The usual length for rails is now universally 15 feet; originally they were made in 3 feet lengths, which occasioned a great number of joints, and tended to produce frequent irregularities in the top line of rail.

The best iron for rails is entirely free from cinder, which tends quickly to the destruction of the rails when in use. Several of the Southampton rails present specimens of the separation of the laminae from the effect of the heavy waggon passing over them.

#### RETAINING WALL.

Where land is very valuable, it is more economical to support the sides of a cutting by retaining walls, than to give them the slopes due to the strata intersected, as in the case of the London and Birmingham Railway, at its approach to the Euston Square Station. These walls are constructed of solid brickwork, with contreforts or piers at intervals, the whole varying in height with the surface of the ground: the face of each wall in vertical section, is the segment of a large circle, the chord of which forms an angle with the horizon of about  $80^{\circ}$ .

#### ROPE.

Ropes are much used in the neighbourhood of Newcastle-on-Tyne, where stationary and self-acting planes abound. A rope  $1\frac{7}{8}$  inches in diameter weighs 2lbs. 2oz., and one of  $2\frac{3}{4}$  inches diameter, 7lbs. 4ozs. per yard. On the Canterbury and Whitstable Railway, the ropes used for the stationary planes are each  $1\frac{1}{2}$  inches in diameter. The rope used on the stationary plane from Euston Square to Camden Town is 7 inches in circumference, and 4080 yards in one length; it was made at Messrs. Huddart's works, at Limehouse. The value of rope fit for such purposes is about 2s. 2d. per lb.

#### ROPE ROLL.

A drum or cylinder usually made of cast iron, and attached to stationary engines, for collecting the rope on its peripheral surface, in drawing a train of waggon up an inclined plane. The rolls



used on the Canterbury and Whitstable Railway, for twenty-five horse-engines, are 5 feet in length between the flanches, and 4 feet diameter.

SCALE—*See Plan.*

The minimum vertical scale for Parliamentary Sections of intended railways, is fixed by the new Standing Orders at 100 feet to an inch.

### SECTION.

Railway sections are always drawn to unnatural scales, that is, the vertical and horizontal measures are greatly disproportioned; the reason of this is plain. If a section drawn to a horizontal scale of 4 inches to a mile, or 1320 feet to an inch, were also to have its heights laid down from the same scale, it would be quite impossible to exhibit the undulations of the country intended to be traversed, where a height of 10 feet would be represented by  $\frac{1}{132}$ <sup>nd</sup> part of an inch, 20 feet by  $\frac{1}{66}$ <sup>th</sup> part of an inch, and so on.

### SELF-ACTING PLANE.

Planes of this kind are chiefly useful where the descending weight preponderates, as the gravity of the descending train effects the ascent of the empty carriages; the rope being attached at one end to the laden carriages, and at the other to the empty ones, passes round a horizontal drum or cylinder fixed at the top of the plane. The form given to the surface of a self-acting plane is found to answer best, when sufficiently curved to counteract the effects of the increasing speed which takes place by the descent of a load in an uniformly inclined plane.

### SIDE SPACE.

The side space is that portion of the top of the embankment or cutting lying between the outer rail and the longitudinal line forming the boundary of the slope, or in the case of a viaduct between the outer rail and the inside of the parapet. Thus the side space of the Greenwich and Canterbury and Whitstable Railways, is about 3 feet; of the Clarence and Whitby Railways, 5 feet; and of the Dublin and Kingstown Railway, near the Dublin Station, 19 feet.

### SHEEVE.

Sheeves are small cast-iron wheels used on self-acting and fixed engine planes, to diminish the friction of ropes which would other-



wise be exposed to friction along the whole length of the planes; they are usually from 10 to 12 inches diameter. On the Canterbury and Whitstable Railway, the sheeves are each of the former diameter, the rope running on them being 3.75 inches in circumference; they are set in wooden frames, and revolve on wrought-iron axles, at a distance from each other of 8 yards. On the Whitby and Pickering Railway, they are set in iron frames let into stone blocks, and are also of 10 inches diameter. There are also wooden friction rollers used on the self-acting plane about  $8\frac{1}{2}$  miles from Whitby, which are 2 feet in length and about 6 inches diameter. This plane being curved laterally to a considerable degree, several of the sheeves are fixed in inclined frames, each varying in inclination according to its place in the curve; the number of sheeves is 174.

#### SIDE CUTTING,

Is the produce of excavations made in ground without the line of the railway, to make up the deficiency in the quantity required for an embankment, or in case the lead from the nearest cutting is at too great a distance.

'SKEW, OR ASKEW ARCH—(*See Oblique Arch.*)

#### SLEEPER.

Sleepers are pieces of timber, either larch, fir, or oak, about 6 feet in length, 9 inches wide, and 5 inches thick, used on newly-formed embankments in lieu of stone blocks, until the full amount of subsidence has taken place; they are placed across the line of railway, at distances of 3 feet from middle to middle; to these timbers the chairs are spiked down.

Some of the oak sleepers, which have been down for a few years on the Leicester and Swannington Railway, are fast going to decay.

On the Southampton Railway, these sleepers are exclusively used, the line passing through districts abounding in larch and fir. Chairs are placed under the sleepers only at the meetings of the rails, at intervals of 15 feet, intermediate chairs being dispensed with; so that the rail, in this case, bears upon the sleeper itself, and is secured to it by strong spikes driven close to the bottom flanch of the rail. On the Croydon Railway the sleepers are laid longitudinally, so that chairs are dispensed with and the rails have a continuous bearing. The same plan is to be adopted on the Great Western line.



## SLOPE.

Slopes are the side faces of cuttings or embankments, formed in point of inclination according to the strata passed through; thus, the slopes of the cuttings between the two tunnels on the Thames and Medway canal, are cut at  $\frac{1}{6}$ th to 1, or 2 inches measured horizontally for every foot in height; in the case either of a cutting or embankment, the slope forms the hypotenuse of a triangle, whose base is the extreme horizontal measure of the slope, and whose perpendicular is the extreme vertical measure.

The plastic clay of London requires slopes of from 2 to 1, to 3 to 1; coal measures usually  $1\frac{1}{2}$  to 1; chalk and gravel in embankments  $1\frac{1}{2}$  to 1, and varying with the nature of the strata in each case.

Slopes are usually strengthened, either by being sown with grass seeds, or facing them with sods cut from the ground, when first broke, turned over, and placed in reserve on one side of the work, until the slopes are ready to receive them.

The embankment crossing the Holyhead Road, on the south side of Coventry, is planted with shrubs, which not only strengthens the slopes, but also gives effect to this lofty mound, which, until this improvement took place, appeared at a little distance as a long red brick wall.

## SLOPED ROAD.

This term applies to roads carried over or under the railway, which are not level. The slope which was formerly allowed for turnpike-roads passed over canals, was 1 in 13. Mr. Walker, in his examination in the session of 1836 before the Committee on railway bills, recommended that the slope for turnpike-roads should be not more than 1 in 30, for public highways 1 in 20, and for occupation-roads 1 in 16. Provisions for the two former descriptions of road are accordingly required to be inserted in all railway bills.

The following will be useful to persons unaccustomed to judge of inclinations of roads:

|                                              |                      |
|----------------------------------------------|----------------------|
| The greatest rise of Holborn Hill is . . . . | 1 in $14\frac{3}{4}$ |
| The average rise . . . . .                   | 1 in 24              |
| The greatest rise of Skinner Street . . . .  | 1 in 18              |
| The average rise . . . . .                   | 1 in 32              |
| The greatest rise of Blackfriars' Bridge..   | 1 in $16\frac{1}{4}$ |
| ————— St. James's Street. . . .              | 1 in 23              |
| ————— London Bridge, Surry                   |                      |
| Side . . . . .                               | 1 in 27              |
| Upper Part of City Road . . . . .            | 1 in 40              |



## SOUGH

Is a drain of small size to convey the surface-water from the top of an embankment into the side drain.

## SPOIL BANK.

A mound of earth raised by the side of a railway, being the surplus from a cutting not required for the embankments, or which, being too far removed, render it more economical to cast it out to spoil.

In some positions, and with particular soils, these banks are rendered fit for cultivation, but the slopes in such case should be made very easy.

## STATION

Is merely a starting or stopping place on a line of railway; when there are warehouses attached to a station, the whole is called a *depôt*. On long lines of railway there are several stations, at which the second class trains stop to take up or set down passengers.

The Euston Station of the London and Birmingham Railway is a good example, the accommodation afforded to the public both for starting and arriving is very complete.

## STATIONARY PLANE.

The same as fixed engine plane, or that which is worked by a stationary engine and rope. Thus, the plane rising from the Euston Station to Camden Town, on the Birmingham Railway, is a stationary plane; and those descending to the town of Liverpool, on the Manchester and Liverpool line.

## STATIONARY SYSTEM

Is the working a railway or some of its planes by means of engines fixed at the tops of the acclivities, the trains or waggons being drawn up through the medium of a rope running round a drum or cylinder attached to the engine.

The greater part of the Whistable Railway is worked by the stationary system, as also of the Cromford and High Peak Railway, in Derbyshire. In the North of England, this system is carried on to a great extent among the Collieries.

The valuable report of Mr. Walker, to the Directors of the Manchester and Liverpool Railway in 1829, on the comparative merits of locomotive and fixed engines, is replete with valuable information as to the cost of working public railways by the stationary system.



**TENDER,**

The carriage accompanying a locomotive engine, with the supply of fuel and water: on the Stockton and Darlington Railway, the tender for water is a truck running on four small wheels, on which is fixed a water butt, five feet in diameter, and five feet two inches in length, its capacity being equal to 600 gallons.

The tenders on the Manchester and Liverpool Railway, with their complement of fuel and water, each weigh from 5 to  $5\frac{1}{2}$  tons. On the Greenwich Railway there is an engine built by Messrs. Forrester, of Liverpool, having the water tank beneath the boiler; the receptacle for coke also forms part of this ponderous machine.

**TERMINAL PLANE.**

The plane at either end of the line, which should for the purpose of starting the engines or checking their velocity on arrival, always be on a descent from the depôt or terminal station.

**TERMINUS.**

The extreme point at the commencement or termination of a railway.

**TRUCK.**

Among the uses to which trucks are applied on railways, the speedy transmission of common road carriages is one of the chief. When the great line of railway is completed between London and Liverpool, families will be enabled to reach the latter place in seven hours, comfortably seated in their own carriages, and carrying their horses with them.

On the Stockton and Darlington Railway, the Yarm Stage Coach is regularly despatched for a distance along that line, and its journey finished by horses.

On the Newcastle and Carlisle Railway, the Carlilse Coach used to form part of the train as far as Hexham, when the line was only thus far completed.

**TON.**

A ton contains 20 cwt., or 2240lbs.



## TRAMWAY.

Tramways or trainways were much used before the introduction of the edge rail; the only public tramway in the southern part of England, is that from Wandsworth to Croydon and Merstham.

It is a double line throughout, and is formed of plates of cast iron, 3 feet in length,  $4\frac{1}{2}$  inches wide, and an inch thick, having an upper vertical guide flanch 2 inches high, and a fish-bellied lower flanch, for the sake of strength. Each way is 4 feet wide in the clear, and the intermediate space is 5 feet; the plates are bedded on blocks of stone, and secured thereto by iron spikes driven into wooden plugs, inserted vertically in the stone.

The waggon used on this way are drawn entirely by horses, and are 5 feet wide, 5 feet long, and 2 feet deep, weighing each about a ton; the wheels, which are 2 feet 8 inches in diameter, are of cast iron, whose rims are  $1\frac{1}{2}$  inches in breadth.

The usual load for a horse is about four tons.

## TUNNELS.

Tunnelling is the art of constructing subterraneous passages, by means either of perforating the earth, through horizontal shafts on the side of a hill, or by sinking vertical shafts after the manner of a well; the latter is the most frequent method. In the present state of railway operations, very few lines can be carried through a great extent of country without resorting to this tedious and expensive method.

The tunnels on the Manchester and Liverpool railway are three in number; the first ascending from the Wapping Station to Edgehill is 2,200 yards in length, 22 feet wide, and 16 feet high; the side walls are perpendicular for 5 feet in height, supporting a semicircular arch of brick, but some portions of the roof are formed through the natural rock. This tunnel was executed by means of vertical shafts. The small passenger tunnel descending from Edgehill to the original station in Crown-street, is 290 yards in length, 15 feet wide and 12 feet high.

The new tunnel descending to the station in Lime-street, is about one mile in length, 25 feet in width, and 19 feet in height; at the western entrance, the arch is segmental, and rises 12 feet 6 inches.

On the Birmingham Railway there are several tunnels amounting in length to little more than  $3\frac{1}{2}$  miles.\* The principal are those of Primrose Hill, Kensall Green, Watford, Weedon, Kilsby and Birkswell.

\* Mr. R. Stephenson's evidence on the Brighton Railway, Session 1836.



The Primrose Hill Tunnel is 1250 yards in length, 22 feet high, and 22 feet wide. The vertical shafts, three of which are left open for ventilation, are five in number, and are of about nine feet clear diameter. The brickwork is 18 inches, or 2 bricks in thickness, and built for the most part in cement; the stratum passed through is the plastic clay of London. At the top of each of these shafts a horse gin was set up and kept at work during the operation, for the purpose of lowering the bricks and other materials, and raising the clay excavated. The entrances are rather too architectural, the situations being such as to prevent their beauties from being seen to advantage.

The Watford Tunnel is carried through chalk, which Mr. R. Stephenson, the engineer, describes as of a jointy nature, and mixed with flints, and that great difficulties have presented themselves in its execution. The whole length is 1 mile 39 yards. In executing it, vertical shafts, similar to those of Primrose Hill Tunnel, were used: about the middle, two large shafts, for the purpose of ventilation, are left open: together 45 feet in length by 32 feet in width. The sides are segments of circles; the wall between them is 3 feet in thickness, at the middle. A great deal of the chalk excavated is carried to spoil.

The tunnel or archway at Kensall Green is about a quarter of a mile in length, and was executed by excavating the ground, and shoring up the sides during the operation of building: it is considerably curved in its length.

The Kilsby Tunnel, about 2200 yards in length, has proved to be the most difficult to execute, on account of the strata passed through being to a certain extent a running sand, which is one of the most troublesome enemies to tunnel operations.

The Box Tunnel on the Great Western Railway is 25 feet wide and 30 feet high.

On the first plane of the Canterbury and Whitstable Railway, ascending from Canterbury, the tunnel is half a mile in length, 12 feet wide, and 12 feet high. On the Newcastle and Carlisle Railway, which is about 60 miles in length, there is but one very short tunnel. On the Leeds and Selby Railway, which is a great passenger line, there is one tunnel, towards the Leeds end, 2100 feet in length, 17 feet in height, and 22 feet in width, on an inclination of 1 in 210. The ventilating shafts are three in number.



On the Whitby and Pickering Railway, there is a small tunnel, about 130 yards in length, 10 feet wide, and 14 feet in extreme height. The side-walls are vertical for 9 feet, and support an 18-inch arch of brickwork. The design of the entrances is in the castellated style of architecture, and forms a striking feature amid the romantic scenery of the Eske.

The tunnel on the Leicester and Swannington Railway is about 1760 yards, or a mile in length, 10 feet 8 inches in width at surface of rails, and 11 feet 5 inches at springing of semi-circular arch, which, as well as the whole structure, is of brick, 18 inches or two bricks in thickness; the total height is 13 feet 6 inches. There are four large vertical shafts, which were used for carrying on the works, about 5 feet in diameter in the clear; and eight ventilating shafts, 8 feet high above ground, and 3 feet diameter in the clear.

The passage through this tunnel is rendered very disagreeable by the use of coal for the engines; but it is to be observed, that this line is not especially designed for passengers, the chief traffic being in coals, and granite from the Groby Quarries; nevertheless, there are frequently seventy passengers in a day passing along some part or other of the line. The usual speed in passing through this tunnel is at the rate of about 14 miles an hour: the plane is level.

A printed Report, signed by Drs. Paris and Watson, Mr. Lawrence, Mr. Phillips, and Mr. O. Lucas, as to the probable effect of the passage through tunnels, has been obligingly transmitted to us. The experiment made by them was in the new tunnel near Primrose Hill. The western end of the tunnel was only partially opened; the ventilation, therefore, was not so complete as it is at present, the whole being now finished. "We found," says the Report, "the atmosphere dry, and of an agreeable temperature, and free from smell; the lamps of the carriages were lighted, and in our transit inwards, and back again to the mouth of the tunnel, the sensation experienced was precisely that of travelling in a coach by night, between the walls of a narrow street. The noise did not prevent easy conversation, nor appear to be much greater in the tunnel than in the open air."

The Reports of Drs. Davy and Rothman, and also of Dr. Williamson, senior physician of the Leeds General Infirmary, as to the Leeds and Selby Tunnel, are equally satisfactory.



## TURNPLATE,

Or turning platform, is a horizontal and circular frame of wood, movable on a centre; it is furnished with a floor of the same material, on which are fixed short rails, at a gauge corresponding with that of the railway where it is set up. The use of this contrivance, which is by no means of recent introduction, is to alter the direction of an engine or carriage, at any angle that may be required. On the Stockton and Darlington Railway, these turnplates are 10 feet in diameter. At the Manchester and Liverpool depôts, there are turning platforms 5 feet in diameter.

## TURNPIKE-ROAD.

There are so many turnpike-roads required to be altered, in consequence of the general introduction of railways, that the size of arch to carry these roads under the latter, is a question worthy of especial attention.

The Metropolis Roads' Commissioners require, in the act of each railway traversing the roads under their management, a clause which fixes the clear height at 18 feet, and the width at 30 feet. In the neighbourhood of a city, or large town, these dimensions should be strictly adhered to. It is well known that some of the highly-laden waggons which leave London, especially for the western portion of England, are too high to pass under the arch of Temple Bar, whose extreme height, in the clear, is 17 feet 9 inches. At Manchester, the bridge over Water-street, which is about 16 feet in height, is found inconveniently low. On most turnpike-roads, however, 16 feet will be found of sufficient height, but the shape of the arch should be semi-elliptic, or, which is better, a horizontal iron bridge should be introduced. The advantage of this is, that uniform height is preserved from one side to the other.

On the Holyhead road, the height of Birmingham Railway bridges is about 16 feet in the clear.

The following statement will furnish engineers, and others interested in this question, with data for their guidance.

Temple-bar is 17 feet 9 inches high and 21 feet 3 inches in span.

The gateway of the Angel Inn, Farringdon-street, is 18 feet 6 inches high and 8 feet in width.

The entrance to the Rose Inn, Farringdon-street, is 13 feet high and 7 feet 9 inches in width.



The entrance to Thavies Inn, Holborn, is 13 feet in extreme height and 8 feet in span.

That of Gray's Inn, 11 feet high and 9 feet 6 inches wide.

The Parliamentary guage for the height of luggage on the tops of stage coaches, is 9 feet 9 inches.

The height of a stage coach is 7 feet 6 inches, and average width 6 feet 3 inches.

The height of a London omnibus to the head of an average driver, is 11 feet, and of a hackney coach, 10 feet 3 inches.

### VELOCITY.

The average speed of the engines leading the first class trains on the Manchester and Liverpool Railway, is about 20 miles an hour, including the ascent either of the Whiston or Sutton inclined plane, the one of which rises at the rate of 1 in 96, the other of 1 in 89. These trains are always assisted by an additional engine. There is only one stoppage, which is at Newton, to take in water, and for the convenience of passengers going to Warrington and other places in the neighbourhood.

The second class trains generally occupy two hours in performing the journey, but they stop at several different stations along the line.

On the evening of Saturday, the 29th December, 1836, when the snow was yet on the ground, the night train, consisting of the usual complement of carriages, performed the first 15 miles from Manchester in 35 minutes, which is at about the rate of 25 miles an hour.

On the Clarence Railway, the speed of the locomotives is limited to 8 miles an hour.

On the Stockton and Darlington Railway, the passenger-trains proceed from the former to the latter place, at an average speed of 12 miles an hour.

On Thursday the 26th May, 1836, the Samson engine, with six wheels, each 4 feet 6 inches diameter, cylinder 14 inches, stroke 18 inches, built by Messrs. Hawthorne, of Newcastle, made its first trip from Blaydon to Hexham, about 17 miles in length, with speeds averaging from 20 to 30 miles an hour; the whole is upon a gentle rise to Hexham.

The train consisted of five carriages with passengers, seven empty trucks, and one luggage van.

The return to Blaydon was performed in  $35\frac{3}{4}$  minutes, exclu-



sive of stoppages; the train consisted of four carriages, one baggage van, and four trucks laden with pigs of lead.

On the 26th of December, 1836, when snow was lying on the ground to a great depth, the Newcastle train proceeded to Haydon Bridge without interruption, and the passengers being conveyed by a stage coach, drawn by six horses, from this station to Greenhead (the railway between these points not being completed), continued to Carlisle, a distance of 19 miles in one hour and a half, the whole journey of 60 miles occupying about seven hours.

The thirteen miles of common road presented a tedious and dangerous performance; many of the roads in the neighbourhood were quite impassable, so that some of the passengers, whose destination was in a direction right or left of the railway, were obliged to continue on to Carlisle, where the train was not, at so late an hour, expected.

The average speed of the engines on the Leicester and Swannington Railway is about ten miles an hour, including stoppages. On the Grand Junction Railway the distance of 96 miles is performed in  $4\frac{1}{2}$  hours. On the Birmingham Railway, the speed at present does not exceed 20 miles an hour.

#### VERTICAL SHAFT—VENTILATION—(*see Tunnel.*)

#### VIADUCT.

This term is applied to bridges erected across valleys, or for carrying roads over low grounds, or, where it is necessary to pass over a number of streets, as in the case of the Greenwich Railway, which is the most extensive viaduct in the kingdom. Since the establishment of railways, bridges crossing rivers have also been termed viaducts—as the Wharncliffe Viaduct, the Brent Viaduct, the Weaver Viaduct, &c.

#### WATER STATION.

On the Manchester and Liverpool Railway, there is only one water station between the termini, the distance being about  $29\frac{1}{2}$  miles.

The water stations on the Clarence Railway consist of iron tanks, about 10 feet square and 4 feet high, each fixed in the top of a brick building of the same area, and about 7 feet high. There are four in about 17 miles.



## RAILWAYS PROGRESSING.—Nov. 1837.

| TITLES.                                             | Estimated Cost. | Lengths in miles. | ENGINEERS.                  |
|-----------------------------------------------------|-----------------|-------------------|-----------------------------|
| Brandling .....                                     | £110,000        | 16                |                             |
| Birmingham, Bristol, and }<br>Thames Junction ..... | 150,000         | 2 $\frac{3}{4}$   | W. Hosking, Esq., F.A.S.    |
| Birmingham and Derby }<br>Junction .....            | 630,000         |                   | G. Stephenson, Esq.         |
| Bristol and Exeter .....                            | 1,500,000       | 76                | J. K. Brunel, Esq., F.R.S.  |
| Croydon .....                                       | 240,000         | 9                 | Joseph Gibbs, Esq.          |
| Durham and Sunderland ....                          | 102,000         |                   |                             |
| Eastern Counties .....                              | 1,500,000       | 120               | John Braithwaite, Esq.      |
| Great North of England ....                         | 660,000         |                   | T. Story, Esq.              |
| Great Western .....                                 | 2,750,000       | 114               | J. K. Brunel, Esq., F.R.S.  |
| Greenwich .....                                     | 400,000         | 3 $\frac{3}{4}$   | Col. Landmann.              |
| Hayle Railway .....                                 | 64,000          |                   |                             |
| Hull and Selby .....                                | 485,000         | 30 $\frac{3}{4}$  | Messrs. Walker and Burges.  |
| Llanelly Railway .....                              | 200,000         |                   |                             |
| London and Birmingham ...                           | 3,500,000       | 112 $\frac{1}{2}$ | Robert Stephenson, Esq.     |
| London and Cambridge ....                           | 1,200,000       | 53 $\frac{1}{4}$  | Messrs. Walker and Burges.  |
| London Grand Junction ....                          | 600,000         | 2                 | G. Rennie, Esq., F.R.S.     |
| Manchester and Bolton ....                          | 204,000         |                   | Messrs. Hartley.            |
| Manchester and Leeds .....                          | 1,485,000       | 61                | Messrs. Stephenson & Gooch. |
| Midland Counties .....                              | 1,000,000       | 75                | C. Vignoles, Esq.           |
| Newcastle and Carlisle ....                         | 550,000         | 60                | John Blackmore, Esq.        |
| Newcastle and North Shields                         | 120,000         | 8                 |                             |
| North Midland .....                                 | 1,500,000       | 72                | G. Stephenson, Esq.         |
| North Union .....                                   | 500,000         | 21                | C. Vignoles, Esq.           |
| Preston & Wyre (with Docks)                         | 130,000         | 19 $\frac{1}{4}$  | Col. Landmann.              |
| Southampton .....                                   | 1,400,000       | 75                | Joseph Locke, Esq.          |
| South Eastern (London and }<br>Dover) .....         | 1,400,000       | 66 $\frac{1}{2}$  | W. Cubitt, Esq., F.R.S.     |
| York and North Midland ...                          | 370,000         |                   | G. Stephenson, Esq.         |

Of these, the Greenwich, London and Birmingham, Manchester and Bolton, Newcastle and Carlisle, North Union, Southampton, Croydon, Great Western, and Bristol and Exeter, are in the most advanced state. The North Union is rapidly advancing to completion—the Croydon is progressing satisfactorily—the arches contiguous to the Greenwich Railway are completed, and the large cutting at New Cross proceeding rapidly. The bridge across the Surrey Canal is in a forward state, and the embankment from the Kent Road to the viaduct at the Junction with the Greenwich line, is advancing quickly. The bridge over Earl's Sewer is very properly being founded on piles. The works of the Manchester and Leeds are commenced in one or two places. The Greenwich is again in progress between Deptford High Street and the Ravensbourne; the angle formed by the viaduct at Deptford High Street is now being altered into a curved line



for the safe passage of the locomotives. There appear to be no signs at present of altering the leaning arches near Earl's Sewer, draining the works, or rendering the arches water tight; but the transverse iron ties, to prevent the work from spreading laterally, are proceeding gradually. The London and Birmingham is now opened to near Tring, a distance of  $31\frac{1}{2}$  miles from London. The great cutting near this place is in a very forward state, and it is expected that an additional portion will be opened early in 1838. The embankments between London and Tring are far from being settled; the London clay is not at all suited for embankments;—the works between London and Tring are not yet completed. The visibly increased progress made in the large works of the Southampton Railway, within the last few months, must be highly satisfactory to the proprietors: this line is to be opened to a point nearest Guildford, a distance of about 21 miles from London, in May, 1838. The great cutting at St. George's Hill is in a forward state, as also that near Kingston. The arch over the Wandle is completed, and the Wey Viaduct, except the parapets. The Great Western, a work which will differ essentially from all other Railways in the kingdom, is in a very advanced state between London and Maidenhead; the splendid Wharncliffe Viaduct, at Hanwell, has been finished for some months, except the parapets. The Hull and Selby, a line remarkable for its level planes and directness, is progressing satisfactorily. The London Grand Junction, though numbered with the Railways progressing, is in fact at present stopped, four or five arches having been built some months back near Frederick Street, Gray's Inn Road, and the works discontinued; a notice is given publicly of the Company's intention to apply to Parliament for an act to alter and amend, &c. That part of the Eastern Counties, between Old Ford and Stratford, is progressing rapidly; a bridge of one arch over the Lea has been erected, and other arches and culverts are in a forward state.

The estimated cost of the twenty-seven Railways now in progress in England and Wales, and tabulated in the preceding page, is upwards of twenty-two millions sterling!



## RAILWAY ACTS PASSED

IN THE

SESSION OF 1837.

| TITLES.                                                        | Petition presented. | Bill read 1st time. | Bill read 2nd time. | Bill read 3rd time. | Royal assent. | Estimated cost. |
|----------------------------------------------------------------|---------------------|---------------------|---------------------|---------------------|---------------|-----------------|
|                                                                |                     |                     |                     |                     |               | £.              |
| Birmingham & Derby, No. 2                                      | April 12            | April 14            | April 24            | May 25              | June 30       |                 |
| Birmingham and Gloucester Extension .....                      | Feb. 13             | Feb. 27             | Mar. 7              | April 5             | May 5         | 88,105          |
| Bishop Auckland & Weardale                                     | do. 17              | May 1               | May 9               | June 29             | July 15       | 162,954         |
| Bolton and Preston .....                                       | do. 16              | Mar. 10             | Mar. 21             | do. 27              | do. 15        | 349,500         |
| Chester and Birkenhead ...                                     | Feb. 8              | Feb. 20             | Feb. 28             | May 18              | July 12       | 250,000         |
| Chester and Crewe .....                                        | do. 10              | Feb. 21             | Mar. 1              | April 26            | June 30       | 240,000         |
| Commercial (Blackwall) ...                                     | do. 3               | do. 16              | Feb. 24             | June 29             | July 17       | 296,400         |
| Durham (Junction) .....                                        | do. 17              | Mar. 20             | April 19            | do. 15              | do. 3         | 63,530          |
| Durham and Sunderland ..                                       | do. 16              | do. 9               | Mar. 17             | April 21            | June 30       | 79,597          |
| Great North of England, Hurworth, and York ...                 | do. 17              | April 28            | Mar. 8              | May 11              | July 12       | 450,995         |
| Great North of England, Clarence and Hartlepool Junction ..... | do. 17              | Mar. 20             | April 17            | June 1              | do. 3         | 51,099          |
| Great Western (Paddington Extension) .....                     | do. 2               | Feb. 14             | Feb. 22             | Mar. 22             | do. 3         | 250,000         |
| Great Western (Trowbridge)                                     | do. 2               | do. 14              | do. 22              | do. 22              | do. 3         | 15,000          |
| Lancaster and Preston ....                                     | do. 3               | do. 15              | do. 24              | April 6             | May 5         | 250,000         |
| London & Brighton (direct).                                    | Feb. 1              | Feb. 13             | Feb. 21             | July 1              | July 15       | 1,800,000       |
| London and Southampton (variations) .....                      | Feb. 15             | Feb. 27             | Mar. 7              | April 5             | June 30       | 400,000         |
| Manchester and Leeds (variations) .....                        | do. 3               | do. 14              | Feb. 22             | do. 5               | May 5         | 185,000         |
| Manchester and Birmingham                                      | do. 8               | Feb. 24             | Mar. 6              | June 1              | June 30       | 2,100,000       |
| Maryport and Carlisle ....                                     | do. 17              | Mar. 15             | do. 23              | May 28              | July 12       | 180,000         |
| North Midland, Leeds and Derby (variations) ....               | do. 6               | Feb. 15             | Feb. 24             | April 5             | May 5         | 75,000          |
| Preston & Wyre (variation)                                     | do. 14              | do. 24              | Mar. 8              | do. 5               | do. 5         |                 |
| Sheffield and Manchester ..                                    | do. 13              | do. 22              | do. 3               | do. 5               | do. 5         | 700,000         |
| South Eastern, London and Dover (variations) }                 | do. 3               | Feb. 17             | Mar. 1              | do. 5               | July 3        |                 |
| Taff Vale .....                                                | do. 6               | do. 15              | do. 24              | do. 5               | June 30       |                 |
| York and North Midland (variations) .....                      | do. 10              | do. 22              | Mar. 2              | May 4               | June 30       |                 |



LIST OF RAILWAY PLANS LODGED IN THE PRIVATE BILL  
OFFICE FOR SESSION 1838.

- 1 Birmingham, Dudley, Stourbridge, and Wolverhampton.\*
- 2 Brecknock and Merthyr Tydvil.
- 3 Bristol and Gloucestershire.\*
- 4 Buckland and Oxford Union.
- 5 Cambridge and Thetford.
- 6 Central Kent.\*
- 7 Collier Wharfs and Railway.\*
- 8 Cwm Garrow.
- 9 Croydon and Epsom.
- 10 Doncaster and Goole.
- 11 Exeter and Falmouth.\*
- 12 Gateshead and Newcastle-upon-Tyne.
- 13 Gloucester and Bristol.\*
- 14 Grand Junction.
- 15 Great North of England.
- 16 Great Western (Uxbridge and Staines).
- 17 Hants and Wilts Junction.\*
- 18 Harwich.\*
- 19 Hull, Lincoln, and Nottingham.
- 20 London and Brighton (Stephenson's).\*
- 21 London and Brighton (Gibbs's).\*
- 22 Manchester, Leeds, and Goole.
- 23 Morpeth and North Shields.
- 24 Newcastle and North Shields Extension.
- 25 Newport, Abergavenny, and Pontypool.
- 26 Preston and Wyre, and North Union Connexion.
- 27 Richmond and Vauxhall.\*
- 28 Saint George's Harbour Railway.\*
- 29 Sheffield Union.
- 30 South-Eastern and Maidstone.\*
- 31 South-Eastern, Canterbury, Ramsgate and Sandwich.\*
- 32 South Midland Counties.\*
- 33 Swansea and Loughor.
- 34 Taw Vale.\*
- 35 Truro, Redruth, and Penzance.\*
- 36 Whitehaven, Workington, and Maryport.
- 37 North-Union and Chorley.

NOTE.—Seventeen of the above-named projected Railways are described in this volume, and are marked thus (\*).



## PRICES OF EARTHWORKS.

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Prices of Earthworks, as agreed by Mr. Palmer, Mr. Macneill, and Mr. Provis, in forming the estimate for the South-Eastern Railway, and given in evidence, Session 1836.

|                                      |                               |
|--------------------------------------|-------------------------------|
|                                      | <i>d.</i>                     |
| For getting, filling, and emptying,  | $4\frac{1}{2}$ per cubic yard |
| For the first lead of one furlong, { | 1 $\frac{1}{2}$               |
| or 220 yards..... }                  |                               |
| And for every 220 yards addi- {      | 1                             |
| tional lead..... }                   | 4                             |

Prices for Earthworks as given in evidence by Mr. Bidder, Session 1836, on Brighton proposed Railway.

| Length of Lead.<br>Miles. | Cost per Cubit<br>Yard. |
|---------------------------|-------------------------|
| $\frac{1}{4}$ .....       | <i>8d.</i>              |
| $\frac{1}{2}$ .....       | 10                      |
| $\frac{3}{4}$ .....       | $11\frac{1}{2}$         |
| 1 .. ..                   | $13\frac{1}{2}$         |
| 2 .....                   | 14                      |
| 4 .....                   | 18                      |
| Spoil .....               | 8                       |

The average cost of Earthworks, on the different Railways, is about 1s. per cubic yard.

THE END.











PMG 1/2







Whishaw, Francis

Analysis of Railways

London 1838

A.hydr. 1142

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